MESS OFFICERS' MANUAL

MEDICAL DEPT. U.S.A.

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PREPARED BY

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OF FOOD AND NUTRITION OF THE
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PREFACE.

THIS little book has been prepared to facilitate the work of camp nutrition officers. Most of the instruction and advice given by the latter is for the benefit of mess officers and mess sergeants, the large majority of whom in their present employment are undertaking work quite outside their previous experience. It is hoped that some of these mess officers as well as some medical officers will find useful a simple statement dealing with the modern views of food and feeding as applied to army conditions. In some instances, particularly in Chapters VI and VII, instruction concerning the duties, activities and conduct of the mess personnel has been given in dogmatic form; but it should be definitely understood that this has been done merely for the sake of clearness and brevity, and that although representing the result of much experience such instruction is to be regarded as *individual suggestion* or *advice only* and not as having in any sense the force of regulations.

In the preparation of the book, standard texts have been freely consulted, numerous monographs reviewed, and the experience of the survey parties of this Division utilized to the full. Although small and unpretentious, the book will be found to incorporate the practically useful deductions fr
most recent physiological experim

while the analyses contained in Chapter I are mainly taken from the well-known Atwater-Bryant tables, there are also a number of specially made analyses of meat and meat products which differ somewhat at the present time from the compositions previously found. While written primarily for the assistance of army officers, most of the information is equally useful for stewards and dietitians of civil institutions, or in the household.

In a book of this character the use of technical terms is undesirable, yet in those cases where a complicated idea can be expressed by a well recognized word it has sometimes seemed better to employ this word rather than use a whole sentence to explain the same thing. A glossary has been added which should prevent any lack of comprehension.

CONTENTS

CHAPTER I.

COMPOSITION OF FOODS.

FOODS may be defined as the substances which, when taken into the body through the processes of ingestion, digestion and absorption, serve to supply energy, build up new tissues and repair wornout ones, and maintain the normal reactions of the body fluids.

In their general chemical composition food substances are like the living material from which they are produced and the living bodies which they serve to nourish. Thus, living organisms are found to be composed largely of the elements carbon, hydrogen, nitrogen and oxygen with smaller amounts of sulphur, phosphorus, calcium and iron and sometimes other elements in still more minute quantity, and we also find the same elements in our food materials. Since the elements in forming organic compounds of different kinds may unite in an almost infinite number of ways, it is not strange that foods are often complex mixtures of chemically distinct bodies, with great variation in odor, flavor and nutritive value.

Notwithstanding the multitude of different foods, the component substances of which they are made fall into a few classes, each of which presents certain chemical characteristics. These components ar most conveniently classified in the following wa

1. Water.
2. Carbohydrate (sugars and starches).
3. Fats.
4. Proteins (tissue-forming foods).
5. Flavoring substances.
6. Accessory substances (vitamines).
7. Mineral matter or ash.

Very few foodstuffs contain all the above components in such proportion as to give exactly the right nutritional balance; in other words, there is no perfect food, although for the young of the same species which produces it, milk is nearly ideal. Most foods are either lacking in one or more components, or have an excess of one or more, rendering them unsuitable to supply all the nutritive requirements of the animal organism. Hence it is found necessary to make use of many kinds of food substances, so that the deficiencies of some may be counterbalanced by the excesses of others (*e. g.*, meat and potatoes).

Proper feeding depends in a great measure on the successful combining of these different foods. It is therefore highly important that those who are responsible for feeding troops, hospital patients or other groups of persons, be familiar with at least the general facts concerning the composition of common foods and foodstuffs.

WATER.

This food component requires but little discussion. It undergoes no chemical change within the

body, hence it supplies no energy, but serves as a vehicle for the foodstuffs taken in and the excretory products eliminated from the body. The peculiar advantages of water for this purpose are many. It is odorless, tasteless, has the power of dissolving more different kinds of substances than any other liquid, and its rate of evaporation is such as to make easy the satisfactory regulation of the body temperature under great variations of climate. Water is the only liquid existing in very large quantities, and it would have been impossible for life, as we know it, to have arisen without this remarkable compound. Due to the continual loss of water through the excreta, the perspiration and respired air, a constant intake must be maintained or the body will quickly succumb. A man may live without the other food components for a month, but without water he will perish within a few days.

Water is taken into the body as a fluid and also in large quantities as a part of apparently dry foods, *e. g.*, bread, which contains about one-third of its weight as water, and tomatoes and lettuce, which contain as much as 95 per cent. water.

CARBOHYDRATES.

The carbohydrates are compounds of *carbon*, *hydrogen* and *oxygen*, the last two elements being in the same proportion in which they occur in water. The carbohydrates commonly present in food substances may be divided into three main classes:

(*a*) The glucose group, the best known members of which are dextrose (or glucose), levulose or fruit sugar and galactose.

(*b*) The cane sugar group, including cane sugar (sucrose), milk sugar (lactose) and malt sugar (maltose).

(*c*) The starch or cellulose group, which includes starch, dextrin, various gums and cellulose or common woody fiber.

The first two groups have many properties in common; they are soluble in water and possess a sweet taste. The members of the second group are made up by a combination of two members of the first group; for example, sucrose is composed of one part dextrose and one part levulose linked together, and lactose is composed of one part of dextrose and one of galactose. By appropriate means we may convert members of the second group entirely into members of the first group. This splitting, or hydrolysis, as it is called, of the larger double sugars into the smaller members of the first group may be accomplished very easily by heating with a small amount of acid. By heating cane sugar with acid it is converted into a mixture of dextrose and levulose, *e. g.*, cooking acid fruits with sugar. Such a mixture is known as invert sugar and is the form in which the sugars are present in honey.

The members of the third group differ radically from those of the first two groups. With the exception of a few gums they are not soluble in water and do not possess a sweet taste. They are made up of several radicles of the first group linked together.

Thus, starch appears to be made up by the linkage of a large but unknown number of dextrose radicles. This is proved by hydrolyzing starch with acid whence only dextrose is obtained. In exactly this way glucose syrups, the familiar corn syrups, are manufactured from corn starch.

Many animal foods (meat, eggs, butter, etc.) are practically free from carbohydrates, while certain others contain moderate amounts (liver, oysters, fish roe, milk, etc.). In practice, however, nearly all of our carbohydrate is taken in vegetable form, the large majority being either starch, cane sugar or corn syrup. The crystallized sugar of commerce is a remarkably pure product. Disregarding moisture, the content in cane sugar will exceed 99 per cent, so that this is one of our most concentrated foods. Corn syrup is a solution of glucose, dextrin, and probably maltose, the relative proportions of these varying according to the exact details of manufacture. This syrup is materially less sweet than cane syrup, but is highly nutritious. The starch of the diet is found in all vegetables and seeds (legumes, tubers, cereals). The starch itself occurs in the form of granules of many different shapes usually characteristic of the plant of its origin. These starch granules are inclosed in cellulose envelopes which in the natural raw condition are more or less impermeable to digestive juices, and it is for this reason that raw or under-cooked vegetables, *potatoes* for example, are difficult of *digestion.*

FATS.

Fats, like carbohydrates, are composed of *carbon*, *hydrogen* and *oxygen*, but the proportion of carbon is greater and the hydrogen and oxygen are not, as in the carbohydrates, in the ratio of two to one. Fats are present in practically all foodstuffs. Butter, lard and oils are nearly pure fat; meats and nuts contain fairly large amounts, but cereals, fruits and vegetables generally contain only small amounts. Fats when in good condition are mild, bland substances with scarcely any taste. The pleasant flavor of good, fresh butter, olive oil, etc., is due to the small admixture of agreeable volatile substances; on the other hand, the disagreeable and sharp characteristics of rancid butter or other fats are due to the splitting of fats with the liberation of free fatty acid by bacteria or other organisms carrying fat-splitting ferment.

In a manner somewhat analogous to the splitting of complex sugars into simpler ones, we may break fats down into simpler bodies by treatment with an alkali, such as potash or soda. The product of the splitting in this case, however, is not a simpler fat but two totally different substances, glycerine and a fatty acid. In practice, where an excess of alkali is used, the fatty acids and alkali combine to form soap. The great economic importance of glycerine and soap requires the careful conservation of all waste fats.

Fats differ from the sugars by being insoluble in water but very soluble in such liquids as chloroform,

ether and gasoline. The liquid fats, or oils, contain a large proportion of olein, a combination of glycerine and oleic acid, while the hard fats, such as beef fat and tallow, have a large proportion of stearin, a combination of glycerine and stearic acid, or palmitin, a combination of palmitic acid and glycerine. By the process of "hydrogenation," liquid fats, like oils, when treated with hydrogen under suitable conditions are converted into harder fats, which process forms the basis of some of the commercial cooking fats made from vegetable oils. Another kind of fat of importance in the army mess is that obtained directly from rendering fat from meat. Butter and oleomargarine are also used, and it is frequently of interest to be able to distinguish between genuine butter and butter substitute. The tests by which this may be done are given in the chapter on Food Inspection.

PROTEINS.

The proteins are exceedingly complex in constitution and embrace hundreds of definite chemical compounds, the structures of which are not perfectly understood at the present time. All of these compounds contain the elements *nitrogen*, *carbon*, *hydrogen* and *oxygen*, with small quantities of *sulphur* and sometimes *phosphorus* and *iron;* and probably associated with these are also *chlorine*, *magnesium*, *potassium*, *sodium* and *calcium*. The *nitrogen*, *carbon*, *hydrogen* and *oxygen* are united in some *eighteen* different compounds known as amino-acid *which in turn* are combined in various fashions

form the proteins. In this respect these acids may be likened to the letters of the alphabet, and the proteins to the words which may be spelled by building up different combinations of the letters. The possibility of variety is just as great. All of these amino-acids are important, but there are a few which it is absolutely necessary to supply. The protein that lacks one or more of these essential amino-acids is said to be incomplete. One of the best known examples of this sort of protein is gelatin.

Nitrogen occurs in protein in fairly constant amount, 16 per cent. There are some variations from this figure, but it is sufficiently near the average for practical purposes. Hence, when it is desired to find the amount of protein in a food, the amount of nitrogen is determined and its percentage multiplied by the factor 6.25 (corresponding to 16 per cent. of nitrogen in the protein molecule) to obtain the percentage of protein. This is the reason for the explanatory note (N x 6.25) often inserted after the word "protein" in a chemical report. A more correct factor for milk protein is N x 6.38, while for wheat protein it is N x 5.7; but, as already stated, for all general purposes we use the factor N x 6.25.

Protein is the characteristic constituent of the flesh of animals. Other foods rich in protein are cheese, milk and legumes. There is a considerable quantity in cereals and other seeds, a small amount in vegetables and little or almost none in fruits. Gelatin is a in derived from bones, hoofs,

cartilage, etc., by the action of heat. In the ordinary process of obtaining soup stock more or less gelatin is extracted from the bones. Gelatin, as has been said, is an incomplete protein, that is, a protein not containing some of the essential amino-acids. It is of value in the diet, for it contains considerable nutriment, but it alone can never take the place of a complete protein like meat.

Animal proteins occur in meat, in the various viscera and in blood. Milk contains several proteins, the principal one being casein, which is partly in solution and partly in suspension, and lact-albumin, which is in solution. White of egg consists largely of another variety of albumen, which rapidly changes upon heating to a gelatinous or solid condition. The usefulness of a protein cannot be judged by its physical state. Although proteins may variously be solid, semisolid or liquid, this has no bearing on their value as food. The vegetable proteins, while less valuable than the animal, nevertheless have an important part in alimentation; the chief of these vegetable proteins are gluten and those contained in the legumes. Pure proteins, like pure fats, are practically tasteless; the various characteristic flavors of foods containing protein are, in all cases, due to other accompanying substances.

FLAVORING SUBSTANCES.

Besides the food components already mentioned, certain organic substances in very small quantities *are useful in* stimulating the appetite. These ar *the flavoring* materials, spices, etc. They h

practically no direct food value in the sense of contributing energy to the body, but they nevertheless play a highly useful part in increasing the flow of digestive juices, to some extent directly but chiefly by adding to the pleasure and variety of flavor of the diet. Salt, in addition to being a mineral food, may be regarded as a flavoring agent, and it tends to bring out or accentuate the characteristic flavors of other kinds of food. Spices and condiments contribute their own flavors, while many foods naturally possess small quantities of volatile oils, ethers, etc., producing characteristic and frequently pleasing tastes. Various organic acids also contribute to the variety of flavors. Some of the substances enumerated above act directly on the taste mechanism; but many of them are essentially odors rather than tastes, depending on ready volatility at the temperature of the mouth for their physiological effect. Methods of cooking should as far as possible be arranged so as to prevent a loss of natural flavors.

ACCESSORY SUBSTANCES.

In addition to the above there are still other substances which, although present in very small quantities, are essential to correct and satisfactory nutrition. Among these are the so-called *vitamines*. They may be divided into two classes—those soluble in fats (the so-called "Fat-soluble A") and those soluble in water (so-called "Water-soluble B"). Milk and eggs contain both classes in relatively large amounts. Spinach and certain other leaf plants also contain both classes in smaller amount.

Most vegetables are rich in the water-soluble substances, but contain lesser amounts of the fat-soluble. The process of drying (dehydrating) vegetables appears, however, to destroy at least in part the vitamines found in fresh products. On the other hand, dried legumes, upon being allowed to sprout, rapidly become rich in these valuable compounds. Substances found in growing plants appear especially valuable as preventing or curing the scurvy resulting from long-continued diet characterized by the absence of fresh and dependence upon dried or preserved foods. Beriberi is likely to result from a diet largely based on seeds (rice, wheat) from which the external layers have been removed, and these latter have been proved to contain a substance which will prevent or more or less completely cure the disease.

MINERAL MATTER.

The mineral matter, also called inorganic matter or "ash," occurs in foodstuffs partly as such in solution in the juices and partly in combined form with the complex organic matter of the protein. Some minerals are ingested as simple inorganic compounds dissolved in the drinking water or admixed with the other food components. The mineral matter in foods, which is essential for proper nutrition, consists of the elements *iron*, *calcium*, *magnesium*, *potassium*, *sodium*, phosphorus, sulphur *and chlorine.*

Foods.	Components.			Vitamines.		Ash.		Special mineral salts.
	Protein.	Fat.	Carbohydrate.	Water-soluble.	Fat-soluble.	Alkaline.	Acid.	
Meats . . .	1	2	..	..	..	..	+	Potassium, phosphorus.
Fish . . .	1	..	..	..	..	..	+	" "
Bread . . .	2	..	1	..	..	..	+	
Cereals (oats, corn, rice, hominy) .	2	..	1	+	..	..	+	
Potatoes . .	2	..	1	+	..	+	..	Potassium.
Legumes (beans, peas) . .	1	..	2	+	..	+	..	"
Roots (turnips, carrots, beets, etc.) . .	..	..	1	+	..	+	..	"
Onions or cabbage . .	..	..	1	+	..	+	..	Calcium.
Greens (spinach) . .	..	..	..	+	+	+	..	Iron, potassium.
Fruits	..	..	1	+	..	+	..	Calcium, potassium.
Milk	2	1	3	+	+	+	..	Calcium, phosphorus, potassium.
Cheese . .	1	1	..	+	+	..	+	Calcium, phosphorus.
Butter . .	..	1	..	..	+			
Eggs . . .	1	2	..	+	+	..	+	Phosphorus, sulphur, iron.
Oleomargarine	..	1	..	..	+			
Lard	..	1						
Vegetable oils	..	1						
Sugar . . .	..	..	1					
Honey . .	..	..	1					
Syrup . . .	..	..	1					
Molasses . .	..	..	1					
Corn syrup .	..	..	1					

The table on page 18 is intended to picture various foods from the standpoint of their importance in the diet. Under the second column headings, proteins, fats and carbohydrates, the figures 1, 2 and 3 refer to relative importance in the particular food of the respective materials, the figure 1 indicating the greatest value, 3 the lowest value. Thus, meats are important mainly as sources of protein, only secondarily as sources of fat. The figures do not correspond with percentage composition. For example, the percentage of carbohydrate in milk is greater than that of protein or fat, yet milk is not important primarily on account of its carbohydrate, but on account of its protein and fat. In the column headed vitamines the more important sources in the ordinary foods of water and fat-soluble vitamines are indicated. The next column shows whether the ash will be acid or alkali, and the last column shows the particular mineral salts furnished in significant amounts.

ANALYSES.

The following table includes analyses of practically all articles of food which are likely to be encountered in the army. It is of course not suggested that the mess officer memorize any of these analyses. The tables should be used purely as an aid in computing the values of the various constituents of menus.

ANALYSES ARRANGED FOR COMPUTING.

Foods.	Composition.			Weight per pound.			Weight per ounce.			Energy per.		
	P. %	F. %	C. %	P. gms.	F. gms.	C. gms.	P. gms.	F. gms.	C. gms.	Kg. Cal.	Lb. Cal.	Oz. Cal.
)utter	0.4	....	37.9	1.8	.....	171.9	0.11	.....	10.74	1570	712	44.50
canned	0.2	....	17.3	0.9	.....	78.5	0.06	.....	4.91	719	326	20.38
dried	1.6	2.2	66.1	7.3	10.0	299.8	0.46	0.63	18.74	2981	1352	84.50
fresh, E. P.	0.4	0.5	14.2	1.8	2.3	64.4	0.11	0.14	4.03	646	293	18.31
A. P.	0.3	0.3	10.8	1.4	1.4	49.0	0.09	0.09	3.06	483	219	13.69
s, canned	0.9	....	17.3	4.1	.....	78.5	0.26	.....	4.91	747	339	21.19
s, dried	4.7	1.0	62.5	21.3	4.5	283.5	1.33	0.28	17.72	2848	1292	80.75
gus, canned	1.5	0.1	2.8	6.8	0.5	12.7	0.43	0.03	0.79	185	84	5.25
E. P.	6.8	73.8	....	30.8	334.8	.....	1.93	20.93	.....	7141	3239	202.44
A. P.	6.2	67.9	....	28.1	308.0	.....	1.76	19.25	.....	6568	2979	186.19
s, E. P.	1.3	0.6	22.0	5.9	2.7	99.8	0.37	0.17	6.24	1012	459	28.69
A. P.	0.8	0.4	14.3	3.6	1.8	64.9	0.23	0.11	4.06	657	298	18.63
canned	6.9	2.5	19.6	31.3	11.3	88.9	1.96	0.71	5.56	1318	598	37.38
dried	22.5	1.8	59.6	102.1	8.2	270.3	6.38	0.51	16.90	3534	1603	100.19
string, canned	1.1	0.1	3.8	5.0	0.5	17.2	0.31	0.03	1.08	209	95	5.94
resh, E. P.	18.5	20.0	....	83.9	90.7	.....	5.24	5.67	.....	2619	1188	74.25
A. P.	15.7	17.0	....	71.2	77.1	.....	4.45	4.82	.....	2224	1009	63.06
orned, canned	26.0	8.1	....	117.9	36.7	.....	7.37	2.29	.....	1819	825	51.56
ried	39.2	5.4	....	177.8	24.5	.....	11.11	1.53	.....	2110	957	59.81
E. P.	1.6	0.1	9.7	7.3	0.5	44.0	0.46	0.03	2.75	472	214	13.38
A. P.	1.3	0.1	7.7	5.9	0.5	34.9	0.37	0.03	2.18	379	172	10.75
beef	8.8	9.3	....	39.9	42.2	.....	2.49	2.64	.....	1226	556	34.75
hard	11.1	5.0	74.2	50.3	22.7	336.6	3.14	1.42	21.04	3962	1797	112.31
soft	10.0	1.0	58.0	45.4	4.5	263.1	2.84	0.28	16.44	2866	1300	81.25
fast foods[1]	11.0	1.0	77.0	49.9	4.5	349.3	3.12	0.28	21.83	3702	1679	104.94
r	1.0	82.0	....	4.5	371.9	.....	0.28	23.24	.....	7668	3478	217.38
ge, E. P.	1.6	0.3	5.6	7.3	1.4	25.4	0.45	0.09	1.59	324	147	9.19
A. P.	1.4	0.2	4.8	6.4	0.9	21.8	0.40	0.06	1.36	273	124	7.75
sauerkraut	1.7	0.5	3.8	7.7	2.3	17.2	0.48	0.14	1.08	271	123	7.69
ts, E. P.	1.1	0.4	9.3	5.0	1.8	42.2	0.31	0.11	2.64	463	210	13.13
A. P.	0.9	0.2	7.4	4.1	0.9	33.6	0.26	0.06	2.10	359	163	10.19
tomato	1.5	0.2	12.3	6.8	0.9	55.8	0.43	0.06	3.49	586	266	16.63

...lery, E. P.	1	0.	3.3	5.0	0.5	15.0	0.31	0.03	0.94	190	86	5.38
A. P.	0.9	0.1	2.6	4.1	0.5	11.8	0.26	0.03	0.74	154	70	4.38
...eese, American	25.9	33.7	2.4	117.5	152.9	10.9	7.34	9.55	0.68	4294	1948	121.75
...erries, canned		0.	21.1	5.0	0.5	95.7	0.31	0.03	5.98	919	417	26.06
...icken, E. P.	19.3	16.3		87.5	73.9	.....	5.47	4.62	.....	2308	1047	65.44
A. P.	13.7	12.3		62.1	55.8	.....	3.88	3.49	.....	1706	774	48.38
...ocolate	12.9	48.7	30.3	58.5	220.9	137.4	3.66	13.81	8.59	6301	2858	178.63
...coa	21.6	28.9	37.7	98.0	131.1	171.0	6.12	8.19	10.69	5119	2322	145.13
...rn, canned	2.8	1.2	19.0	12.7	5.4	86.2	0.79	0.34	5.39	1005	456	28.50
green, E. P.	3		19.7	14.1	5.0	89.4	0.88	0.31	5.58	1036	470	29.38
A. P.	1.2	0.4	7.7	5.4	1.8	34.9	0.34	0.11	2.18	401	182	11.38
...nmeal	9.2	.9	75.4	41.7	8.6	342.0	2.61	0.54	21.38	3646	1654	103.38
...nstarch			90.0	.....	.....	408.2	.....	.....	25.51	3691	1674	104.63
...ckers (all kinds)	10.7	8.8	71.9	48.5	39.9	326.1	3.03	2.49	20.38	4206	1908	119.25
...rants, dried	2.4	7	74.2	10.9	7.7	336.6	0.68	0.48	21.04	3298	1496	93.50
...s, E. P.	13.4	10.5		60.8	47.6	.....	3.80	2.98	.....	1526	692	43.25
A. P.	11.9	9.3	....	54.0	42.2	.....	3.38	2.64	.....	1354	614	38.38
..., salmon, canned, E. P.	21.8	12	....	98.9	54.9	.....	6.18	3.43	.....	2019	916	57.25
canned, A. P.	19.5	7.5	....	88.5	34.0	.....	5.53	2.13	.....	1497	679	42.44
..., cod, fresh, E. P.	16.5	0.4	....	74.8	1.8	.....	4.68	0.11	.....	714	324	20.25
A. P.	8.4	0.2	....	38.1	0.9	.....	2.38	0.06	.....	364	165	10.31
mackerel, fresh, E. P.	18.7	7	....	84.8	32.2	.....	5.30	2.01	.....	1427	647	40.37
A. P.	10.2	4.2	....	46.3	19.1	.....	2.89	1.19	.....	809	367	22.94
salt, cod, E. P.	25.4	0.3	....	115.2	1.4	.....	7.20	0.09	.....	1069	485	30.31
A. P.	19.0	0.4	....	86.7	1.8	.....	5.39	0.11	.....	816	370	23.13
mackerel, E. P.	21.1	22.6	....	95.7	102.5	.....	5.98	6.41	.....	2967	1346	84.12
A. P.	16.3	7.4	....	73.9	78.9	.....	4.62	4.93	.....	2286	1037	64.81
smoked, haddock, E. P.	23.3	0.2	....	105.7	0.9	.....	6.61	0.06	.....	974	442	27.63
A. P.	15.8	0	....	71.7	0.5	.....	4.48	0.03	.....	657	298	18.63
herring, E. P.	36.9	15.8	....	167.4	71.7	.....	10.46	4.48	.....	2983	1353	84.70
A. P.	20.5	8.8	..	93.0	39.9	.....	5.81	2.50	.....	1658	752	47.00
...ur	11.4	1.0	75	51.7	4.5	340.6	3.23	0.28	21.29	3640	1651	103.19
...apefruit, E. P.	0.6	0	12.2	2.7	0.5	55.3	0.17	0.03	3.46	527	239	14.94
A. P.	0.4	0.1	8.9	1.8	0.5	40.4	0.11	0.03	2.52	379	172	10.75
...ape juice	....	.. .	15.0	.....	.....	68.0	.....	.....	4.25	615	279	17.44
...m, E. P.	13.8	35.0		62.6	158.8	.....	3.91	9.92	.....	3821	733	108.31
A. P.	12.2	30.8		55.3	139.7	.....	3.46	8.73	.....	3364	1526	95.38
minced	22.1	20.6		100.2	93.4	.....	6.26	5.84	.....	2822	1280	80.00
	14.3	3.0	7.5	64.9	13.6	34.0	4.05	0.85	2.13	1173	532	33.25

ANALYSES ARRANGED FOR COMPUTING.—*Continued.*

Foods.	Composition.			Weight per pound.			Weight per ounce.			Energy per.		
	P. %	F. %	C. %	P. gms.	F. gms.	C. gms.	P. gms.	F. gms.	C. gms.	Kg. Cal.	Lb. Cal.	Oz. Cal.
iny, dried	7.7	0.9	78.3	34.9	4.1	355.2	2.18	0.26	22.20	3611	1638	102.38
lye canned	2.2	0.2	17.8	10.0	0.9	80.7	0.63	0.06	5.04	838	380	23.75
ream, commercial	2.5	15.1	18.2	11.3	68.5	87.1	0.71	4.28	5.44	2253	1022	63.88
army recipe	5.8	5.1	33.3	26.3	23.1	151.0	1.64	1.44	9.44	2077	942	58.88
	1.0	....	60.0	4.5	.....	272.2	0.28	.....	17.01	2502	1135	70.94
, E. P.	17.6	23.1	....	79.8	104.8	.....	4.99	6.55	.....	2870	1302	81.37
A. P.	14.1	18.7	....	64.0	84.8	.....	4.00	5.30	.....	2317	1051	65.69
and substitutes	....	100.0	....	.....	453.6	.....	.....	28.35	.....	9299	4218	263.63
ns, E. P.	1.0	0.7	8.5	4.5	3.2	38.6	0.28	0.20	2.41	454	206	12.88
A. P.	0.7	0.5	5.9	3.2	2.3	23.1	0.20	0.14	1.44	317	144	9.00
ce, E. P.	1.2	0.3	2.9	5.4	1.4	13.2	0.34	0.09	0.82	196	89	5.56
A. P.	1.0	0.2	2.5	4.5	0.9	11.3	0.28	0.06	0.71	163	74	4.63
, calf	19.0	5.3	1.4	86.2	24.0	6.4	5.39	1.50	0.40	1329	603	37.69
roni	13.4	0.9	74.1	60.8	4.1	336.4	3.89	0.26	21.01	3671	1665	104.06
evaporated	7.1	7.8	9.6	32.2	35.4	43.5	2.01	2.21	2.72	1411	640	40.00
fresh	3.3	3.5	5.0	15.0	15.9	22.7	0.94	0.99	1.42	666	302	18.88
skimmed, powder	35.4	1.2	48.1	160.6	5.4	218.2	10.04	0.34	13.64	3536	1604	100.25
on, E. P.	15.5	32.1	....	70.3	145.6	.....	4.39	9.10	.....	3620	1642	102.63
A. P.	12.5	26.0	....	56.7	117.9	.....	3.54	7.37	.....	2930	1329	83.06
eal (rolled oats)	16.7	7.3	66.2	75.8	33.1	300.3	4.73	2.07	18.77	4079	1850	115.63
alad	....	100.0	....	.....	453.6	.....	.....	28.35	.....	9299	4218	263.63
nargarine	0.8	86.7	....	3.6	393.3	.....	0.23	24.58	.....	8095	3672	229.50
s, E. P.	1.1	27.6	11.6	5.0	125.2	52.6	0.31	7.83	3.29	3086	1400	87.50
A. P.	0.8	20.2	8.5	3.6	91.6	38.6	0.23	5.73	2.41	2260	1025	64.06
as, E. P.	1.6	0.3	9.9	7.3	1.4	44.9	0.45	0.09	2.81	498	226	14.13
A. P.	1.4	0.3	8.9	6.4	1.4	40.4	0.40	0.09	2.52	450	204	12.75
ges, E. P.	0.8	0.2	11.6	3.6	0.9	52.6	0.23	0.06	3.29	527	239	14.94
A. P.	0.6	0.1	8.5	2.7	0.5	38.6	0.17	0.03	2.41	381	173	10.81
hes, canned	0.7	0.1	10.8	3.2	0.5	49.0	0.20	0.03	3.06	481	218	13.63
dried	4.7	0.7	62.6	21.3	3.2	283.9	1.33	0.20	17.75	2824	1281	80.06
ut butter	29.3	46.5	17.1	132.9	210.9	77.6	8.31	13.18	4.85	6226	2824	176.50
s, canned	0.3	0.3	18.0	1.4	1.4	81.6	0.09	0.09	5.10	778	353	22.06
green, canned	3.6	0.2	9.8	16.8	0.9	44.5	1.02	0.06	2.78	569	258	16.13

a, dried	24.6	1.0	62.0	111.6	4.5	281.2	6.97	0.28	17.58	3644	1653	103.31
les, cucumber	0.5	0 3	2.7	2.3	1.4	12.2	0.14	0.09	0.76	159	72	4.50
apple, canned	0.4	0.7	36.4	1.8	3.2	165.1	0.11	0.20	10.32	1574	714	44.63
k, fresh:												
ham and shoulders, E. P.	12.6	42.3	....	57.2	191.9	.....	3.57	11.99	.....	4451	2019	126.19
A. P.	10.4	35.0	....	47.2	158.8	.....	2.95	9.92	.....	3682	1670	104.38
loin, E. P.	15.8	30.6	....	71.7	138.8	.....	4.48	8.68	.....	3494	1585	99.06
A. P.	11.4	22.2	....	51.7	100.7	.....	3.23	6.29	.....	2531	1148	71.75
k, salt, E. P.	8.1	72.5	....	36.7	328.9	.....	2.30	20.55	.....	7075	3209	200.56
A. P.	7.4	66.5	....	33.6	301.6	.....	2.10	18.85	.....	6488	2943	183.94
toes, sweet, E. P.	1.8	0.7	27.4	8.2	3.2	124.3	0.51	0.20	7.77	1263	573	35.81
A. P.	1.4	0.6	21.9	6.4	2.7	99.3	0.40	0.17	6.21	1012	459	28.69
canned	1.9	0.4	41.4	8.6	1.8	187.8	0.54	0.11	11.74	1812	822	51.38
toes, white, E. P.	2.2	0.1	18.4	10.0	0.5	83.5	0.62	0.03	5.22	853	387	24.19
A. P.	1.8	0.1	14.7	8.2	0.5	66.7	0.51	0.03	4.17	686	311	19.44
es, E. P.	2.1	....	73.3	9.5	.....	332.5	0.60	.....	20.78	3091	1402	87.63
A. P.	1.8	....	62.2	8.2	.....	282.1	0.51	.....	17.63	2623	1190	74.38
pkin, canned	0.8	0.2	6.7	3.6	0.9	30.4	0.23	0.06	1.90	326	148	9.25
ns	2.3	3.0	68.5	10.4	13.6	310.7	0.65	0.85	19.42	3181	1443	90.19
	8.0	0.3	79.0	36.3	1.4	358.3	2.27	0.09	22.40	3596	1631	101.94
age, beef	18.9	19.2	....	85.7	87.1	.....	5.36	5.44	.....	2560	1161	72.56
pork	13.0	44.2	....	59.0	200.5	.....	3.69	12.53	.....	4643	2106	131.63
p	....	....	71.0	.....	.....	322.1	.....	.....	20.13	2912	1321	82.56
hetti	12.1	0.4	76.3	54.9	1.8	346.1	3.43	0.12	21.63	3662	1661	103.81
ach	2.1	0.3	3.2	9.5	1.4	14.5	0.60	0.09	0.91	245	111	6.94
sh, canned	0.9	0.5	10.5	4.1	2.3	47.6	0.26	0.14	2.98	514	233	14.56
r	....	....	100	.....	.....	453.6	.....	.....	28.35	4101	1860[3]	116.25
ow	....	80.0	....	.....	362.9	.....	.....	22.68	.....	7438	3374	210.88
oca	0.4	0.1	88.0	1.8	0.5	399.2	0.11	0.03	24.95	3633	1648	103.00
atoes, canned	1.2	0.2	4.0	5.4	0.9	18.1	0.34	0.06	1.13	231	105	6.56
atoes, fresh	0.9	0.4	3.9	4.2	1.8	17.7	0.26	0.11	1.11	234	106	6.63
key, E. P.	21.1	22.9	....	95.7	103.9	.....	5.98	6.49	.....	2994	1358	84.88
A. P.	16.1	18.4	....	73.0	83.5	.....	4.56	5.22	.....	2372	1076	67.25
nips, E. P.	1.3	0.2	8.1	5.9	0.9	36.7	0.37	0.06	2.30	403	183	11.44
A. P.	0.9	0.1	5.7	4.1	0.5	25.9	0.26	0.03	1.62	280	127	7.94
l, E. P.	20.7	6.7	....	93.9	30.4	.....	5.87	1.90	.....	1473	668	41.75
A. P.	18.3	5.8	....	83.0	26.3	.....	5.19	1.64	.....	1290	585	36.56

P. = "edible portion." A. P. = "as purchased." P. = "protein." F. = "fat." C. = "carbohydrates."

[1] "Breakfast foods" is an average of all the proprietary breakfast foods in common use.
[2] "Hash"; this analysis is of a well-known commercial canned-beef hash.
[3] In computations of scientific accuracy use 1795 calories per pound.

SAMPLING.

It may become necessary at times for the mess officer to take samples for transmission to a chemical laboratory. This will generally be with the object of determining the nutritional value and healthfulness of such samples. This matter of sampling is of far greater importance than is generally realized, and often calls for great skill and discrimination in order that the small portion sent to the chemical laboratory may accurately represent the average mass of material sampled.

In the case of material like flour, if a five-pound sample is to be taken, half-pound portions should be taken from each of ten different packages. In sampling bulk material the aim must be to get as many small portions as possible from different parts of the bulk. Liquids should be thoroughly mixed and small portions taken from as many containers as possible. Package goods such as extracts in small bottles, canned goods, etc., cannot be opened conveniently, so that several of the smallest units are to be taken and shipped in the original containers. Butter, oleomargarine and cheese should be sampled by taking plugs, by means of a trier, from as many packages as possible. These plugs should then be placed in an air-tight container to prevent escape of moisture.

The selection of a proper container calls for considerable care. Glass fruit jars of appropriate size are generally the most satisfactory, but require great care in packing. Acid liquids, like vinegar, should not be put in metal containers. Perishable

material, like meats, sausage, etc., require a preservative in order to prevent decomposition. For this purpose the sample should be well shaken up with a little formalin. The following table gives the usual quantities required for general examination of various products. Special investigations of any particular material may, however, require larger amounts.

For analysis take:

Substances.	Quantity.
Butter	1 pound.
Baking powder	8 ounces.
Canned goods	3 cans.
Cheese	1 pound.
Extracts (lemon, vanilla, etc.)	4 ounces.
Flour (for chemical analysis)	1 pound.
Flour (for baking test)	5 pounds.
Jam, jelly, etc.	1 pound.
Oleomargarine	1 pound.
Oils (olive, cottonseed, etc.)	1 pint.
Sausage	1 pound.
Syrup and molasses	1 pint.
Spices	4 ounces.
Vinegar	1 quart.
Soft drinks	24 bottles.

CHAPTER II.

SELECTION AND INSPECTION OF FOODS.

NOTES on judging the quality of the more important foods are contained in this chapter.

MEATS IN GENERAL.

In purchasing any kind of meat or meat products it should be remembered that unscrupulous dealers can dress them up in such a way as to deceive all but the most expert. Only *reliable dealers* should be patronized and no meats should be purchased that do not bear the "U. S. Inspected and Passed" stamp. The stamp will usually be found in the following places on the various kinds of meat mentioned: beef—flank, back, leg; veal—leg, loin, rib, breast; mutton and lamb—forequarter, rack, leg; hog carcass—head, hams; fresh pork—rib inside; hams—skin; all sausages—brands on the package or container, with the exception of minced ham and luncheon meat, branded on the casing as well; liver, brains and other organs—branded on the container.

BEEF.

Beef should be "well covered" with fat. The carcass should weigh at least 450 pounds and present a clean, light yellow appearance of fat extending well down to the shanks, indicating a young

animal. Furthermore, in high-grade meat the flesh will be marbled with fat. A good indication of the age of the animal is given by the condition of the bones of the vertebral column. In animals under six years of age these bones are not completely ossified, *i. e.*, there will be found a considerable cartilaginous area on the ends of the vertebræ. The spaces between the vertebræ will appear pink in color in young animals.

Meat derived from the various classes of bovine animals varies considerably in value, cow, bull and stag beef being least desirable. The objection to these is based on the fact that as cattle are handled in farm practice, animals of these classes come to market late in life, after having been used for breeding purposes; that is, cow, bull and stag beef is usually from old animals, and as such is discriminated against (1) because it is likely to be tough and dry, (2) because the proportion of forequarter and of bone is higher than in younger animals, and (3) because the fat in beef from younger animals is more evenly distributed and is disposed more largely within the muscles and less largely as a surface covering than in older animals. Since cow beef is prohibited by army regulations while spayed heifer beef is accepted, one should know how to judge the age and sex. And due to the fact that steer beef is considered to be better quality than bull beef, it is well to be able to distinguish between the five kinds, viz., cow, spayed heifer, steer, bull and stag. A *spayed heifer* is a female from which the ovaries were removed early in life. A steer is a castrate

male, while bulls are uncastrated. Stags are bulls which were castrated late in life, the operation having been performed so that they would put on fat before slaughter. First, look for the spermatic cord, which is located in the hindquarters at the upper end of the pelvic bone, or just superior to the ischium, of steers, bulls and stags, and is easily recognized by its color. It lacks the redness of the surrounding flesh,—it is pale reddish white, of a "gristly" appearance, and round or oval in cross-section. Of course it is not to be found in the hindquarters of cow beef. Another method is to look for the cod or scrotal fat on the belly surface of the hindquarters. It is possible to be misled, as some unscrupulous dealers cut the udder fat of the heifer to simulate the cod fat of the male. This attempted deception should not, however, cause much difficulty, since the udder fat always presents a structural or cellular appearance which, when once seen, is readily distinguished from the cod fat. The pelvis of the cow is much wider than that of the male animal, and a layer of fat which in male animals extends well down to the "H" (aitch) bone is higher above this bone in the female.

To distinguish between bull (or stag) and steer carcasses is not so easy for the novice. The meat of a bull or of a stag is darker in color than that of a steer and is often of coarser texture. The neck and shoulders of a bull or stag are much more massive than those of a steer, and after one has had some experience in examining known specimens he can learn to tell by a glance at the forequarters or

by the appearance of the cut meat the class of male animal from which it was derived. Caution must be exercised before passing on a female carcass so as not to condemn a spayed heifer as a cow. Usually the scar from the spaying operation is discernible on spayed heifer carcasses. Another index is the condition of the bones, *i. e.*, by the amount of cartilage. Furthermore, the vertebræ of heifers are very tender and the sawed edges are crumbly to the feel. From a strictly chemical point of view there is no objection to the meat of cows, bulls or stags. The objection is largely economic; cows, bulls and stags are generally rather old when slaughtered and their flesh is coarser, tougher and drier than that of steers or spayed heifers; of these, steer carcasses are to be preferred because of the greater ratio of meat to bone. The hindquarters represent 48 per cent. and the forequarters 52 per cent. of the total weight of the carcass. For more detailed information see articles 2303 to 2306, *Manual for the Quartermaster Corps;* and *Inspection Manual of the Subsistence Division, Quartermaster Corps.*

To judge the freshness of a carcass, rub the fingers on the inner surface of the pelvic cavity in the hindquarter and the inner surface of the diaphragm (or skirt)[1] or thoracic cavity in the forequarter. Note whether they are dry to the touch or whether they are wet or slimy. A dry condition means freshness;

[1] The present quartermaster specifications (October 28, 1918) require the skirt to be entirely removed, so that in the army meat it should never be found. This regulation was introduced because it is noted that decomposition usually commenced under this structure. When beef is n[ot] obtained through the quartermaster the skirt will frequently be fo[und]

a slimy condition indicates the beginning of decomposition. A wet but not slimy feel may merely mean "sweating," due to a cold carcass having been hung in a warmer atmosphere. A carcass should not be condemned on account of a slightly slimy condition, since this may be only superficial and can be removed by washing in a salt and vinegar solution or by trimming; but one should use great reserve in purchasing beef in this condition; it is apt to be in an unfit state when finally received by the cooks. On account of the possibility of infection with a dangerous form of microörganism the presence of slimy beef in the mess kitchen should not be tolerated, in spite of the fact that it is common practice in hotels to allow meat to "ripen" or become "high" before the preparation of the tender "filets," etc. Such meat properly kept does not become slimy.

Another simple test of the freshness of beef is the "knife" or "blade" test. Thrust a knife blade into the meat at right angles to the direction of the fibers and note whether there is any resistance when it is withdrawn. Stale meat does not cling to the blade—it has lost its elasticity and the blade will have a disagreeable odor when withdrawn. The cut surface of decomposing meat gaps open, whereas fresh meat will generally squeeze shut. In making these tests with a knife or trier it is necessary to bear in mind that if any infection exists on the surface of the meat it may by the introduction of the instrument be carried into the center. Therefore these tests are not desirable unless the meat is to be consumed soon. A form of spoilage that ma

not be discerned superficially is souring of the interior of a side of beef. This is due to the fact that the beef was not cooled through before shipping or was frozen too quickly on the surface, resulting in the interior being left warm and thus allowing decomposition changes to develop.

OTHER MEATS AND POULTRY.

HORSE FLESH.—While horse flesh is not extensively used in the United States, it is a quite common article of food on the Continent of Europe and may be met with in France. There is no physiological objection to eating horse meat, but it should be bought at a lower price than beef. It is easy to recognize horse meat, when hung in the form of quarters, by its shape. When cut up it is not so easy and sometimes impossible to tell the difference between a specimen of young horse flesh and beef. The fatty covering of the carcass is quite yellow and is oily, due to the large proportion of olein in the fat. The meat is generally of a dark dull red color. The grain of the flesh is coarse, somewhat like bull beef, but, unlike bull beef, is rather soft to the touch. The flesh is not marbled with fat as are the better grades of beef.

LAMB AND MUTTON.—Lamb is less than one year old. The kidneys should be well covered with fat and the caul, or omental fat, should be thick and plentiful. Lamb can be differentiated from mutton by the smaller size of the animal and by the fact that the bones of the foreleg will break before the joint will yield. In the case of lamb the fore

bones break near the joints and show roughened ends, whereas in the case of sheep the bones have ossified and do not break, showing the rounded joint. Further, by examination of the bones of the hindlegs one may judge of the age. Those of the lamb are reddish or pink well down to the ends, while those of mutton are white. These are called the "blood bones." Castrated lambs are known as "wethers" in the meat trade. Goat can be distinguished from lamb by the small neck and shortness of the foreleg as compared to the humerus, and frequently some hairs of the goat may be found on the carcass; there may also be a characteristic odor. This odor is due to the sexual development of the animal and is especially pronounced in meat which has been cooked and has begun to cool.

PORK.—The color of fresh pork should be red to pink and the muscles of fine texture, with an abundant deposit of fat between them. In old hogs the meat is dark and there is less fat distributed within the muscles, although the animal is likely to be much fatter than a young one. Boars are not accepted in the army. Unsexed male (barrow) carcasses may be distinguished from sow carcasses by the presence in the former of the spermatic cord.

SMOKED HAM AND BACON.—The skins on first quality hams should be smooth and have no cuts. Cuts are indicative of the removal of bruised and diseased spots. A barrow is a hog castrated early in life, while a stag is castrated after reaching sexual maturity. Both barrow and stag hams show the spermatic cord, but stag hams have much thicke

skins than barrow or sow. Since stag hams are likely to be tough and fibrous they should be avoided. Decomposition in ham starts along the bone and cannot, therefore, be detected by superficial examination. A "trier," that is, a steel rod or skewer, should be inserted through the ham along the bone and upon withdrawal smelled for putrefactive or sour odor. It is quite easy to tell when a ham is not fresh by this test. A wooden skewer may be used, but it is not as good as steel. The appearance of a mold on the surface of ham is not to be viewed with alarm, provided the "trier" test[1] reveals a sweet condition inside, though the mold should be removed before using the meat. Bacon is also tested with a "trier." Sow belly bacon can be detected by the teats. Sometimes the teats are removed with intent to make it appear as barrow belly. Close examination will foil the attempted deception, since barrow bacon has a strip of muscle next the skin which is absent in sow belly bacon.

VEAL.—Veal should be of a pale red color and fine, though fairly strong, muscle fiber. The meat of immature calves is very light in color, of softer consistency and watery. Veal should be examined very critically, since it is apt to be the cause for severe gastro-intestinal disorders when even slightly slimy. It should be looked upon with great suspicion if it shows any slime in the peritoneal or pelvic cavities, and certainly should not be used for food if the other surfaces are slimy.

[1] *See also* page 30 for "knife" or "blade" test.

POULTRY.—Good poultry has firm flesh an
[illegible] skin, which is tender under the wings and l
[illegible] will easily break or tear if fresh upon bea
back the wings or legs. Stale poultry loses its f
[illegible] and the skin becomes green or bluish over
[illegible] and abdomen. Decomposition sets in firs
the tips of the wings, if the quill feathers have l
removed and at the "knee" joints. The rear en
the sternum or breast bone is very flexible and te
in young chickens, and this distinguishes them f
hens. However, it is a common trick with pou
dealers to break the end of the sternum of hen
order to impart the feeling of tenderness to
part characteristic of the younger fowl. S
fowl are sometimes found.

BRAINS, LIVERS, KIDNEYS AND HEARTS.—
[illegible] reliable dealers handle only meats slaugh
and inspected for diseases under Government s
[illegible] It is practically impossible to detect
[illegible] meats in the butcher shops after they
been prepared for sale. If the organs are dis
the Government inspector condemns the entire
carcass. If the animals are not killed under Go
ernment supervision and inspection, glands and or
showing the diseased condition are destroyed
the remainder offered for sale. If the animals
not inspected when killed all that remains fo
purchaser is to see that the meat is fresh. Or
[illegible] and elastic to the touch
[illegible] decomposition begins
[illegible] e substance softer.
[illegible] lost and a

or putrefactive odor is present. In the advanced stages of decay the organs become sticky, smeary and sloppy, while the color becomes grayish, yellowish or greenish. Proficiency in judging meat products comes only with practice.

Brains.—Brains spoil very quickly and their general use in the camps during the summer months is not advisable. They mold rapidly and tend to become bluish in color; but color is an unreliable guide, because even in fresh brains it varies a great deal. When not fresh, brains become slick and slimy and have a sour or putrid smell.

Beef Livers.—Beef livers when fresh vary in color from light brownish to dark brown, and some are almost purple. Calf livers are lighter in color, smaller and more desirable. Livers spoil quickly, becoming lighter in color and mottled, and the surface is sticky and slimy. The color and feeling must be considered with the odors. Livers sour first and then become putrid. The inspector's stamp is burned into the tissue by means of a hot iron brand and is not easily seen.

Kidneys.—Kidneys are much like liver in so far as detection of deterioration is concerned. They should be bright and even in color, reasonably dry and firm to the touch. Kidneys smelling sour or putrid are not fit for food.

Beef Hearts.—Beef hearts are usually used in sausage. When the hearts are fresh the red blood can be pressed from the small vessels. Hearts remain fresh longer than do livers. When unfit for food they become sticky to the touch and pale in col and lack the distinctive fresh meat smell.

SAUSAGES.

Sausages are usually made of the cheapest meats and edible viscera, consisting mainly of hearts, spleen and tripe. The Navy has its sausage made from meats alone. No such materials as organs are allowed to be used. Sausages made of meat or of edible viscera, and which contain no cereal and water, are branded with a circular stamp by the Government inspectors. The regulations of the Department of Agriculture permit the labelling of products containing 2 per cent. of cereal as "sausage," but the product or its container must be marked to show the addition of cereal. If more than 2 per cent. of cereal is added it cannot be labelled as "sausage" and must be marked with a brand showing the ingredients. Both of these latter products are inferior in food value to sausage made from meat and edible organs only, and should be purchased at a lower price. Fresh sausages are bright and fresh in color and dry to the touch unless sweating after being removed from a cold room. Slimy, sticky, moldy sausages should not be used. Dealers may wash such sausages in salt water and deceive the purchaser. To test the odor, break the sausage and bring the broken place to the nose quickly before the odor is lost. Sausages containing cereal when decaying have a yeasty smell.

FISH AND OYSTERS.

Fish.—It is generally a very simple matter to *know when fish* is not fresh by the odor. The eyes

of fresh fish stand out, are bright and the film over them is transparent. Sunken eyes indicate staleness except in the case of deep sea fish, whose eyes are sunken naturally. Gills of stale fish lose their normal red color. Fresh fish sink when thrown into water. They are generally quite rigid when held in a horizontal position by the hand. The gills and mouth should be closed.

OYSTERS.—Oysters should never be purchased from any but the most reliable sources, since there is danger of their being carriers of disease bacteria as a result of coming from polluted waters while they are apparently of very good quality. Only certified oysters should be served in a soldier's mess, and they should never be eaten raw. If the shells are open it is proof that the oysters are dead, and they should always be rejected.

FARM PRODUCTS.

EGGS.—The condition of eggs is determined by "candling." This operation consists in holding the egg before a source of light and noting the condition inside the shell. A candling apparatus is easily made; it consists merely of an opaque cylindrical collar which can be slipped over an electric bulb or other source of light, a round hole a little smaller than an egg being cut in the cylinder. Candle light was formerly and is now quite extensively used, hence the name. If this simple apparatus be placed in a dark room, eggs held before the opening will appear strikingly translucent. A fresh egg will show the outline of the yolk intact in the center. The

yolk should not adhere to the shell as the egg is rotated nor lie on the bottom of the shell. There should be no black spots, *i. e.*, mold or blood, and the air space at the end should be small. A large air space signifies long storage of the egg. If the yolk is not distinctly marked, or if it cannot be seen at all, the egg is decidedly rotten. Eggs with unclean shells (known to the trade as "dirties") should be rejected.

MILK.—Milk should not be purchased from any but very carefully inspected dairies. The source should be known and have the sanitary inspector's approval, since milk may appear of excellent quality, taste sweet, but at the same time be extremely dirty. Numerous epidemics have shown that raw milk may harbor dangerous disease organisms, especially typhoid and paratyphoid bacilli, or the streptococci of septic sore-throat. It is regrettable that this is the case, since milk is one of our most valuable foods. In view of these facts milk should be thoroughly pasteurized by heating to 140° to 145° F. for thirty minutes and then immediately chilled to 45° or below and kept cold.

CANNED MILK.—Due to the fact that the process of sterilization of canned unsweetened milk kills *all dangerous bacteria*, this is a safe form in which to use milk. On account of the safety in its use, and the possible danger in the use of fresh milk, it is usually better to exclude fresh milk altogether in favor of the canned or desiccated. *Desiccated* or *dried milk* in the form of powder or scales has been used for a long time by bakers. It is a very eco-

nomical form for army use from the standpoint of transportation, since the water is entirely removed. Modern methods of manufacturing it produce an excellent and entirely safe product. It is used extensively in the British and Canadian armies. One of the best forms of desiccated milk is that produced by spraying (atomizing) the milk into a blast of hot air. In this way very fine subdivision is effected, with the result that an enormous area is exposed to evaporation and the latter is almost instantaneous. For this reason the temperature of the milk is never materially raised and the ferments originally present are not injured, nor is any "cooked milk" taste produced. *Reconstituted milk* is the product of vigorously agitating, by means of a suitable machine, skim-milk powder with warm water and sweet butter, emulsifying the mixture and chilling. The liquid so obtained is an excellent substitute for fresh milk, and if properly made cannot be distinguished from the latter by appearance, odor or taste. More recently whole milk also has been desiccated by spraying, and is satisfactory if used while in a fresh condition. When this product is employed no butter is required.

BUTTER AND OLEOMARGARINE.—The general quality of these fatty foods can be easily judged from the odor, taste and appearance. There should not be excessive beading of moisture nor deposits of salt crystals. Nutritionally[1] they are of equal value provided the oleomargarine contains at least

[1] See page 125.

[illegible] per cent. of butter fat. A satisfactory
[illegible] accessory substances, soluble in
[illegible] abundantly present in butter. Unfortuna
[illegible] inadequately supplied by oleo oil,
[illegible] wise to discard entirely b
[illegible] although the amount of the latter requir
[illegible] objections to oleomargarine are m
[illegible] but there is also the economic objecti
[illegible] oleomargarine when butter prices
[illegible] therefore it is desirable to be ab
[illegible] between them. There are
[illegible] which, taken together, make
[illegible] The first is called the "boilin
[illegible] A small lump of the sample is p
[illegible] carefully heated, with con
[illegible] butter will boil quietly, but
[illegible] foaming. The foam will often swe
[illegible] the spoon even when taken
[illegible] heat. Oleomargarine will b
[illegible] like hot grease containing wate
[illegible] Renovated butter acts in this
[illegible] giving a slight foam. Observ
[illegible] in the spoon after heating will rev
[illegible] difference. In the case of pure b
[illegible] curd will be exceedingly f
[illegible] The curd from oleomargarine and
[illegible] butter will collect in fairly large lumps.
[illegible] mentioned is the *Waterhouse*. A c
[illegible] well-mixed sweet milk are heated n
[illegible] boiling in a small tin and a sample of about
quarter ounce of the fat to be tested is a
The mixture is then stirred, preferably with a

ɜn stick, until the fat is melted. The tin is ɔlaced in a dish of ice-cold water, and shortly : the fat starts to solidify—which will take ps five to ten minutes after the mixture is l in cold water—stirring is resumed and con-l until the fat reaches the solidifying point. sample is oleomargarine the fat can readily lected by the stirring stick into a lump or clot; butter it cannot be so collected but remains ınular condition, distributed throughout the n small particles. The behavior of renovated · is intermediate between that of genuine but-d oleomargarine; renovated butter fat when l in the cooled milk almost instantly gathers m on the surface of the milk when the stirring pped and shows little tendency to remain ɜd throughout the liquid as does the fat of ıe butter. (Leach's Food Analysis.)

VEGETABLES AND LEGUMES.

'ATOES.—Smooth, regularly shaped potatoes, ıably uniform in size, with comparatively few ɪre to be preferred on account of economy in ;. Potatoes which have been well ripened are desirable than immature ones on account of ronger skin and better keeping qualities. A ɔotato should feel firm, should separate crisply cut with a knife and be of even density ;hout. When cut in two, one-half should hold :her suspended to it after rubbing the two *together*, and there should be no dripping ɜr *from* the cut. Potatoes that have

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s already stated,
the factor N x 6.25.
Protein is the ch
flesh of animals.
cheese, milk
ntity in

are firm or solid and have the tops well contracted and dry.

CABBAGE.—Good cabbage is crisp, firm and solid. The outer leaves show little discoloration at edges.

CARROTS, TURNIPS AND BEETS.—These vegetables should be smooth and solid and not sprouted. Avoid withered specimens.

BEANS should be examined for the presence of splits, mouldy beans and those which are immature and undeveloped. Possible weevils or anthracnose infections are liable to be encountered. Anthracnose, a bacterial disease, is recognized by a brown or black spotted appearance. Poisonous beans of the lima type, grown in tropical countries, have made their appearance in our markets. They are dangerous on account of the large amount of a compound which yields the deadly poison hydrocyanic ("prussic") acid which they contain. In general, large, flat lima beans which are white, or at most only faintly tinted, but not speckled or mottled, are entirely safe. Small flat, white or colored limas, and small thick, white or cream-colored limas are apt to be dangerous. Some of these small varieties of limas contain as much as one grain of hydrocyanic acid in four ounces of beans, an amount that is decidedly dangerous for human consumption. Since there are many varieties of the common or navy bean which greatly resemble the dangerous varieties of the lima bean, it is necessary to be able to distinguish between common beans and limas, since the common bean is never *poisonous*. The common bean is smoo

and covered with a network of interlaced veining while the veining of the lima bean is a series o raised lines radiating from the hilum ("eye") outward and never crossing each other. Comparison of a navy bean with a lima bean will quickly demonstrate this striking difference. The poisonous variety of limas comes mainly from India and part of South America, especially Brazil.

CEREALS AND CEREAL PRODUCTS.

The cereals most widely used in military camp are flour, cornmeal, oatmeal and rice. These should be tested for physical characteristics, dirt and insect pests. Examination of wheat flour is made by the feel, odor and color and by the cohesivenes when some of it is squeezed in the hand. Flour rich in gluten will tend to cohere in a mass. Good flour is soft and powdery to the touch, but usually has a slight grittiness when rubbed between the thumb and forefinger. This gives a good indication of its quality as to hardness. Very highly milled patent flours usually show little or no grittiness With cornmeal the odor is important and some o the meal should be carefully inspected for evidence of moldiness. Such meal should be rejected. Similar inspection is made of oatmeal. Rice should be flinty and bright, almost lacking in odor and free from dirt. All these products are subject to the action of weevils, which during hot weather may develop in considerable numbers. With rice the weevils may be discovered and removed by placin the bags in the hot sun and then sweeping off t

insects which come out. With flour this is much more difficult, and the best plan is to keep only a limited supply of flour on hand during hot weather. This supply should not exceed the requirements of thirty days. If wetted all these products tend to become sour, especially in hot weather. Cereal products, such as breakfast foods, macaroni, spaghetti and crackers, should be examined as to the occurrence of eggs or larvæ of weevils; also with reference to staleness resulting from dampness. Macaroni and similarly formed foods should be examined by holding them up to the light, because eggs or larvæ are often found on the inside.

BREAD.—Bread should be tested with reference to the character of the crumb and the crust. In the crumb the color, odor, taste and the size of the holes caused by the gas should be noted. These in well-made bread will average perhaps one-sixteenth of an inch in size and the bread should be elastic and spongy in texture. If over-fermented during the rising the holes will be much larger, the bread will dry out quickly and may have a sour or yeasty taste; if under-fermented or slack-baked the bread will be heavy, dense and sticky. The crust should be darker in color than the crumb, but should not be burned. It should be brittle rather than tough. Taste and odor are perhaps the best tests to apply to bread.

Rope is a disease which occurs in bread, manifesting itself by an unpleasant odor and by the formation of a glutinous mass, which can be pulled out to such a length that it resembles a rope, hen

name. Rope is caused by bacteria and the latter are practically always first introduced into a bakery by the flour. The bacillus of rope forms spores in the dough which are not killed in the oven because the temperature of the dough at the center of the loaf, where rope first makes its appearance, never goes above the boiling-point of water and stays at that point for too short a time to kill the spores. After the bread has been taken out of the oven and cooled the bacteria develop rapidly from the spores, and within twenty-four to seventy-two hours have grown to such an extent as to make the bread worthless. As is common with most other bacteria, rope grows more rapidly in a warm damp medium, so that it is especially to be feared in summer.

However, rope is very susceptible to acid. Rope is therefore easily cured by the addition of an acid to the dough batch. Lactic acid and acetic acid, the latter in the form of vinegar, have been most successfully used. The first thing to do when rope is found in any bread coming from a bakery is to make a thorough cleaning of everything in the building. After this, wash the entire bakery and all the utensils with warm vinegar or warm dilute lactic acid or warm dilute sulphuric acid. Then add to the dough batch, for each 100 pounds of flour used, 1 pound of strong vinegar (containing 9 to 10 per cent. of acetic acid, commonly known as 90- or 100-grain vinegar) or 2 pounds of table vinegar (containing 4.5 to 5 per cent. of acetic acid, commonly known as 45- or 50-grain vinegar). In case lactic acid is used, add 1 pound of a 10 per cent.

solution of lactic acid per 100 pounds of flour. In a few cases when substitutes are used, some of these are more alkaline than wheat flour, and it will be necessary to add a little more acid to the dough.

CANNED FOODS.

Spoiled canned goods can in many cases be detected by the external appearance of the can. A normal can of fruit or vegetables presents a clean appearance, and the ends should be flat or slightly concave. This concavity is due to a vacuum in the can caused by the method of processing. Cans are to be inspected for "leakers," "swells," and "springers" or "flippers." "Leakers" are generally characterized by the light weight of the can and contents; they can usually be recognized by the soiling of the box or paper covering, by the escaped contents and sometimes leaky cans can be detected by careful inspection of the seams. This type of spoilage is caused by imperfect soldering or by a slight leak developing in the seams of the can, allowing microörganisms to enter and part of the contents to run out, or by action of the contents upon the metal. The hole generally becomes clogged and the fermentation proceeds rapidly, bulging out the ends of the can. A leaker will often discolor the outward appearance of other cans in a case, but these must not be regarded as spoiled unless they also show signs of defective vacuum. Leakers should be rejected.

A "swell" is a can in which some reaction generating gas has taken place, and this gas bulges out

one or both ends, causing such pressure inside that both ends cannot be pressed inward and kept there without continued application of outside force. A swell may even be so hard that it cannot be pressed in at all by the hand. In the case of acid fruits a swell, while undesirable, may not be dangerous. With beans, peas or meats, and to some extent with corn, on the other hand, swells may be very dangerous, since putrefaction or protein fermentation has taken place; that is, swells are likely to be dangerous with any canned food which contains a considerable proportion of protein.

A "springer" or "flipper" is a can with a defective vacuum. Neither end necessarily protrudes, but on striking one end squarely downward against a hard, flat surface with considerable force the lower end will bulge out in case the vacuum is defective. Pressing on this bulged end returns it to its place with a "flip," where it stays. Knocking it again will cause it to bulge as before, although it will stay in if pressed back. Another way to make this test is to strike the cap (top) on a wooden surface and note whether the other end becomes convex. This should not occur in a perfectly normal can. Any convexity resulting indicates a slight pressure or at least lack of a normal vacuum. There is also a slight difference in sound when tapped with a knife or other implement. A swollen can gives a dull sound as compared with the tympanitic note of a perfect one. The contents of such cans are edible in a certain percentage of cases, but whether they are edible or not can only be determined definitely

by an expert (usually only by bacteriological examination) since the type of spoilage that sometimes is found in them produces no recognizable change in appearance, odor or taste. The Quartermaster-General has ruled that all cans showing defective vacuum shall be returnable for credit; consequently the responsibility for disposal of these cans and the protection of the men in the mess rests entirely upon the mess force. If through carelessness the men are fed food from any such cans and sickness results, the mess force is to be held directly responsible. The number of cans stored in any kitchen or storeroom is usually far too large to permit of the mess sergeant or mess officer inspecting them every day. Inasmuch as any individual can is liable to become spoiled the instruction regarding identification of spoiled cans should be extended to the entire mess force.

In very warm weather, or if the cans have injudiciously been put in a warm place, good cans will sometimes act like springers. In order to determine whether such cans are springers because of the high temperature or whether they have in reality a defective vacuum, they may be placed in a refrigerator for a few hours. If after being in a refrigerator they still spring as described, when struck, they are to be classed as springers and returned. Cans of acid fruits and preserves sometimes have springing or bulging tops. These are not always harmful, since gas may be generated by the action of the contents upon the metal of the can. The final test is to open the can and examine the contents by taste and smell.

A form of spoilage that cannot be detected before opening a can is known as "flat sour." Canned corn and baked beans are subject to this form of spoilage. It can be detected by the sour, sometimes only faintly perceptible, abnormal taste, and is not necessarily dangerous, although always objectionable. However, even though some evidences of spoilage do not always spell danger to health, it is better to be on the safe side and *reject all cans which show any symptoms of possible deterioration.* If there is any doubt about the wholesomeness of a case of canned goods, and the evidence is not sufficient to warrant condemnation, put the case in a warm place for two or three days. This will favor the rapid development of any fermentation or putrefaction if the organisms are present and the true condition of the cans will become apparent. In inspecting and returning defective canned goods mess officers should be governed by the following letter, dated May 24, 1918:

MAY 24, 1918.

File No. 432.2–701 (Sub-1) General.
From: Acting Quartermaster-General.
To: Depot Quartermaster, New York, N. Y.
Subject: Disposal of canned foods when containers are of questionable appearance.

1. Some of the containers of canned vegetables fruits, meat and meat-food products and other canned foods delivered to the Army do not show *proper vacuum.* The food in such containers may *or may not be sound.*

2. *The contents* of those cans known as "swells

and "leakers" are unsound because of fermentation or putrefaction. The contents of other cans, commonly known as "springers" and "flippers" (those showing loose tin or insufficient vacuum) and overfilled cans, usually are found to be sound.

3. To distinguish between those two classes of canned foods, the containers of which have a questionable appearance, requires expert knowledge. It is impracticable to provide special inspectors having expert knowledge of canned foods for the examination of those products at all camps, especially at those where only a few troops are stationed. For this reason canned foods should not be issued to troops unless the containers are in perfect condition and show a good vacuum. Inexperienced persons should not attempt to differentiate between questionable cans, the contents of which may be sound or unsound, but should reject all those packages which are not in perfect condition.

4. The term "good vacuum" means that the ends of round cans, large sides of flat cans and the sides and ends of high four-side cans should be tightly drawn, and should neither show tin nor distention.

5. All canned goods, the containers of which are not in perfect condition, should be held for reclamation. Swells, springers, flippers, overdefects should all be included in this class. Immediately after the discovery of canned foods showing any one of these conditions the facts should be reported to the depot or purchasing quartermaster in order that arrangements may be made with the contractor to re

the rejected products. (See paragraphs 809 and 2310, Manual for the Quartermaster Corps.)

By authority of the Acting Quartermaster-General:

J. W. McIntosh,
Lt.-Colonel, Q. M. Corps, N. A.,
Subsistence Division.

CCA/BWB
C–116

DRIED FOODS.

Dried Fruits.—Dried fruits in most common use are apples, prunes, peaches, raisins and apricots. These should be examined as to their color and general appearance and for evidence of moulds or insect life. The most common moulds found will be those of the Penicillium and Aspergillus types, and they will generally be apparent on the surfaces of the mass of fruit. They can commonly be removed by washing. Inspection should also be carried out for small cobweb-like masses indicative of the development of certain forms of insect life. The mass of fruit should also be broken open to inspect for the larval stages of fruit flies and other insects which may be found in the interior away from the light. If the amount of water in dried fruits is too large they are also subject to souring or rotting, which will in general be apparent by a mushy consistency and disagreeable or sour odor. Mites also may develop on such fruits in large numbers.

Dehydrated Vegetables.—These products have been but little used in the camps in America, but their use is extending They may be encountered n the foreign The principal vegetables

employed are the potato, onion, tomato and small amounts of turnip, carrot and cabbage, and mixtures of these and other vegetables known as a soup mixture or "Julienne." These dehydrated vegetables should have a pleasant odor, should be free from any sourness or putrefaction and should be of good color, although less intense in the case of pigmented vegetables than in the fresh material. The changes to which these foods are subject are negligible if proper containers and storage conditions are employed (see Chapter III). In moist climates, however, if badly stored they will absorb moisture and undergo moulding and slow changes by bacteria. A moist feel, lack of crispness and the occurrence of moulds should be most carefully looked for.

Finally, in view of the fact that so much food is purchased locally rather than from the Quartermaster, it is very desirable that the mess officer should acquaint himself with sanitary conditions prevailing in the establishments selling foods. From the Public Health Service and the Division Sanitary Inspectors there is usually considerable information to be had. It has often been observed that the mess officers do not avail themselves of these data and show little interest in this important phase of food inspection.

CHAPTER III.

STORAGE OF FOODS.

THE storage of foods in quantity is necessary in order to guarantee a constant adequate supply. To prevent loss of stored foods through spoilage it is necessary that special means be taken to protect them. The conditions of storage, the temperature and moisture of the surroundings and the length of the storage period determine in great measure the sanitary quality and nutritive value of both perishable and semi-perishable foods. The problems of food storage therefore are of vital importance, for unless the food is stored in the proper kind of containers and in proper surroundings it will soon cease to be food and may be an actual menace to health.

Practically all foods are subject to deterioration, but there is a difference in the character and rate of spoilage. Meats, milk, butter, open canned goods, many fresh vegetables and other products containing a large amount of water undergo deterioration rapidly; while foods such as cornmeal, beans, flour and really dry fruits spoil only very slowly because the lack of water does not permit the development of the microörganisms causing spoilage. There is a distinct difference in the kind of change foods may undergo when spoilage occurs. Nitrogenous foods

become gradually "off" in flavor and finally foul or putrid, while starchy and sugary foods become distinctly sour rather than putrid, and may also develop a flavor of mouldiness or "mustiness." In the army mess it is especially important that the mess officer see to it that the food provided for his organization is stored under the best conditions. The ration allowance provides sufficient food for the men in the mess if there is no loss by spoilage; but any spoilage in effect cuts down the ration allowance correspondingly and renders proper feeding of the men more difficult.

Storage of foodstuffs may be considered under six headings: (1) The Refrigerator, (2) Meats, (3) Dairy Products, (4) Vegetables and Dry Foodstuffs, such as flour, cornmeal, rice, sugar, etc., (5) Canned Goods and (6) Bread. Most of the foodstuffs considered under the second and third headings require refrigeration; those belonging to the remaining groups none.

THE REFRIGERATOR.

A refrigerator is a box constructed primarily for the purpose of cooling foods; it is not for the purpose of storing ice. Since in the construction of the refrigerator the primary purpose is to provide space for the storage and cooling of foods, there is set aside for the ice as small a space as practicable. It is intended that this ice chamber be kept well filled with ice at all times; if the ice supply is reduced the efficiency of the box from the standpoint of refrigeration is inevitably and invariably impaired. It is impossible to keep the ice chamber well f

if ice is taken therefrom for the purpose of cooling drinks. A rule should be laid down, and rigidly enforced in every mess, namely, that under no circumstances may any ice whatever be removed from the ice compartment. Perhaps the best way to control the situation is to provide a staple and hasp, and padlock the ice compartment, allowing this compartment to be opened only at the time of

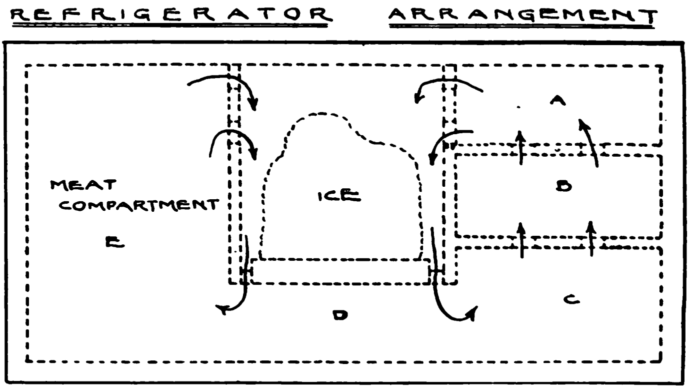


FIG. 1.—Refrigerator.

cleansing and refilling with ice. It is important that a refrigerator be not only cold but dry. Therefore any water or other liquid that has collected should be carefully removed whenever the box is inspected.

The mess officer should impress upon the mess sergeant and cooks the necessity for keeping the refrigerator doors closed tightly at all times. The doors should not be opened unless necessary, and when they

must be opened they should be closed as quickly as possible. It should be remembered that cool air is heavier than warm air and every instant that the refrigerator door is not tightly closed the heavy, cooled air inside the box is spilling out on the floor and being replaced by warm air which afterward must be cooled by the refrigerator before it returns to its former temperature inside. A refrigerator of excellent quality, the ice compartment of which is kept well filled with ice, may be inefficient from the standpoint of proper food refrigeration through the carelessness of the mess force in the matter of opening and closing the box. The doors should never be simply slammed shut; the handle should receive the last final turn which presses the outer flange of the door tightly against the box. If the doors become warped they should be promptly repaired. It should not be possible to pass the finger nail into any crack between the outer flange of the door and the box after the hasp has been tightened. In case the hasp is loose and will not force the door shut under pressure, it may be necessary to remove one of the metal pieces of the hasp and raise it from the door by cutting and placing under it a piece of stiff cardboard, or better of metal.

The principle of refrigeration is this: if a mass of warm food, for example beef, is hung in a compartment of the box, air coming in contact with it is warmed. This air is now lighter than it was and rises to the uppermost part of the chamber (Fig. 1). *The partition* between the food chamber and the ice *compartment* is always incomplete at the

that the warm particles of air now move across to the ice compartment, where they come in contact with the ice. As they are cooled they contract and become heavier than before and pass down along the surface of the ice and finally through openings in the floor of the ice compartment, and the cool air can usually be felt by placing the finger along the sides of the lowermost part of the food chamber. In other words, the cooling of foods placed in the ice-box is accomplished by currents of air which pass in this way alternately from the warm food to the ice and back again. Cooling is by circulation of cold air. If the food be piled in the food compartment in such a way as to cut off or retard this circulation the process of cooling will be greatly delayed.

No food of any description should ever be stored in the ice compartment. The reason for this is principally that some food is certain to be spilled sooner or later and find its way downward through the complicated drainage system of the box. This drainage system may be (although should not be) very difficult to clean, and if it becomes befouled with decaying food, odors arise that may be absorbed by certain foods, such, for example, as butter, and render it unfit for use. If the ice compartment is kept locked as suggested above, it will of course be impossible to place food in it.

That the refrigerator should be kept clean at all mes is a rule which should be strictly enforced. should be thoroughly cleansed each day, but ould not be left open too long during the process ng.

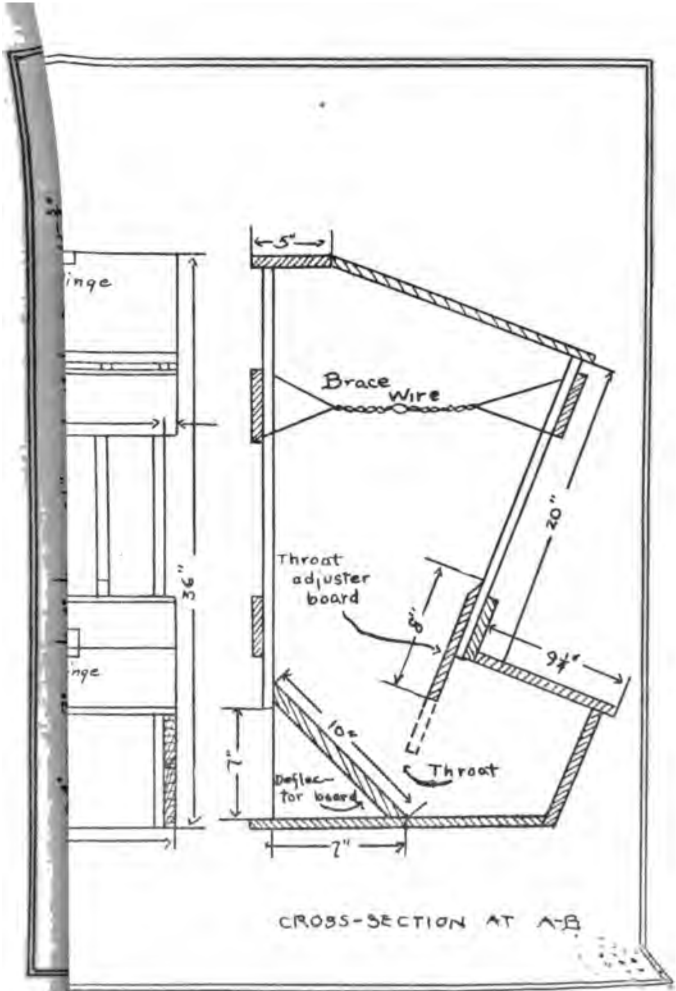
MEATS.

Meats should be stored in a good cool refrigerator and preferably hung on hooks. Overcrowding of the box should be avoided and the meat hung in such a way that good circulation of air is possible. If the meat when first received is covered with "sweat" due to condensation of water from the air when it comes in contact with the cold surface of the meat, it should be carefully wiped until dry, using a clean cloth. Fresh meat spoilage begins at the surface. Moisture is required for the spoilage of any food, and this moist surface is an admirable medium for the development of bacteria. The drying of such a quarter will increase its keeping qualities by many hours. At a temperature of 55° F. it should be possible to keep good dry, fresh meat twenty-four to thirty-six hours with safety. If an average temperature of 45° can be maintained in the refrigerator it should be possible to keep such meat three days or more. Above 57° a refrigerator is inefficient so far as refrigeration of fresh meats is concerned. A thermometer should be kept in the refrigerator and the mess force should be taught to read it whenever the door is opened. The temperature will be found to rise to its highest point shortly after each of the three meals of the day. It should be the aim of the kitchen force to lower these high points as much as possible through greater caution in opening and closing. Meats should *never be placed* directly on ice. for (1) the ice may *not be clean*, (2) it will dissolve out certain sub-

stances from the meat, and (3) i surface in which spoilage goes on f were dry.

DAIRY PRODUCTS.

Dairy products, such as fresh mi oleomargarine, etc., should be stored erator and protected from foods with a such as onions or turnips, since butt will readily absorb the volatile matter o and develop a disagreeable taste. No erators have exactly equal efficiency; maintain an average temperature of 48 another will average 65° F. The mess fo not only determine the average temperatu refrigerator and try to lower it through u measures already mentioned, but should s efficiency of the box in terms of its powe serve foods. Make use of every instance food spoils in the refrigerator to learn how l kind of food may be safely stored. Do n the same mistake twice. Experience will t cooks how long fresh milk may be kept wi in their refrigerator and they should use milk or left-over evaporated milk within tl No opened cans of any food, including ev milk, should be allowed in the refrigerat contents should be emptied into an a pitcher or cup, and this should be place refrigerator for preservation.



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VEGETABLES AND DRY FOODSTUFFS.

The storage of fresh vegetables, such as potatoes, sweet potatoes, onions, turnips, carrots, parsnips, rutabagas, etc., should be in bins that allow free circulation of air and that do not mass too great a quantity of vegetables in one heap. It should be possible to fill the container at the top and draw off foods at the bottom so that no left-overs may remain in the bottom to start spoilage in the new supply when the bin is refilled. Since the requirements for vegetable bins are similar so far as general shape is concerned to those for such dry foods as sugar, flour, cornmeal, beans, dry peas, macaroni (or spaghetti), etc., the type of bin that should be provided for both classes of foods will be considered at the same time (but see page 65). The drawing (Fig. 2) illustrates a bin that is very efficient.

For vegetables this bin should be constructed of slats, leaving about three-quarters of an inch between the slats for ventilation. Only the deflector board, the bottom of the bin, and the lids should be of tight construction. If the deflector board and bottom were made of slats the vegetables would not feed forward rapidly enough. If the doors were made of slats they would be harder to keep clean and would allow dirt to pass through. For the dry foods bins should be of tight construction throughout; if possible, they should be metal lined. The pattern of the end of the bin should be the same no matter whether intended for vegetables or dry foods, and the dimensions for these ends are shown in the drawing. The variable factor then in diffe

ent bins will be differences in length only. The length adopted for any bin should be determined by the bulk of food obtained from the original package; for example, sugar, 100-pound sack, beans, 100-pound sack, etc. In other words, it should be possible to empty the contents of the original package at one time so that no half-emptied sacks need be stored about the storeroom. For most of the dry foods bins twenty inches long are sufficient. In the case of vegetables a bin thirty-six inches long will hold somewhere near four bushels (*e. g.*, of potatoes).

In order to facilitate the proper use of these bins they should all be placed upon a shelf which is at least fifteen inches above the floor. This amount of elevation will not place the upper opening of the bin so high as to render filling difficult, and it will bring the lower opening high enough so that food may be withdrawn without stooping over. If such bins were placed on the floor it would be so much easier to take the food out from the upper opening that the whole purpose behind the adoption of this type of bin would be defeated.

The deflector board in the bottom prevents accumulations at the back. As a matter of fact it may be found desirable in practice to padlock the upper opening, especially in the case of such foods as potatoes. Any left-over potatoes must then be thrown back into the lower opening and thus would be the first taken out again.

The lumber used for the construction of the *slatted bins may* be any type of narrow boards, for

xample, tongued and grooved flooring. Left-overs nay often be found for this purpose, as in the case of the thirty-six-inch bin no piece longer than thirty-six inches is required.

Vegetable deterioration is promoted by storage n a warm damp place, the result being dry or wet rot, wilting or sprouting. If properly sorted when received, and any vegetables which have become soiled with rot from spoiled food be well washed and dried before being placed in the bin, little trouble from any of these causes will be experienced. The sprouts that appear on potatoes, onions, etc., should be removed at once and before they have had a chance to develop. The sprout growth is made entirely at the expense of food stored within the vegetable, and if it goes far enough all the food (*e. g.*, the onion) will be converted into sprout; consequently the sprout should be regarded as a type of food spoilage or wastage, and hence the need for its early destruction.

Such vegetables as rhubarb, celery, radishes, etc., are neither purchased in large quantities, not stored in the mess over a long period, and for them it is not necessary to provide the above type of bin, although it would be well to provide a slatted box or basket which may be kept on an elevated shelf or platform above the floor.

In winter, in addition to deterioration by rotting or sprouting, there is danger of loss from freezing. Vegetables stored in winter should be protected against a freezing temperature. When storage pace in the building is limited or liable to sub-

stored vegetables to freezing, underground pits ma be used. A pit or cellar can be dug under th kitchen, and if properly lined with straw and th side walls neatly boarded, an admirable storag room is obtained. Most vegetables keep well a temperatures varying from a little above freezin to 50° F. In the case of sweet potatoes, howeve in which a fungus disease or dry rot flourishes a low temperatures, it is best to store them in a plac a little warmer than 50° F. The objections to freez ing are (1) a change of taste in the food, and (2) th fact that frozen foods decompose rapidly afte thawing out. Freezing does not alter the food value that is, there is as much food in the potato afte freezing as before. The structure of the potato con sists of minute cells with starch granules inside. I addition to the starch granules, however, these cell are filled with water. As everyone has observed water expands when it freezes, and this expansio breaks up the cells and makes possible infection an destruction of the whole potato substance.

The best way to thaw out frozen vegetables is t place them in cold water and allow them to stan over night before cooking. Vegetables that hav been frozen should be kept frozen if possible unti needed. They will soon spoil after thawing, and i most cases will be a total loss. It is important t keep frozen vegetables separate from unfrozen, s that the "weeping" when thawing out does not we the unfrozen stock.

The problem of storing potatoes, onions and othe *fresh vegetables is one t* not been very ca

fully considered by most mess officers. Too commonly the idea prevails that a large box in which to dump the potatoes, for example, is all that is necessary. The successful and efficient mess officer will certainly not act upon this principle. He will be repaid in the end for any exertion that may be required in providing his mess with the proper kind of food containers. Four of the slatted bins described, about thirty-six inches long, and nine of the smaller tight-construction bins for the dry foods will usually be found sufficient for all ordinary mess needs. When possible all fruits and vegetables should be stored in a cool, dry and well-ventilated place.

In many respects ordinary G. I. (galvanized iron) cans would serve as satisfactory containers for the dry foods, such as sugar, flour, cornmeal, etc. They protect food from dust, also insects, rats, mice, etc., and are easily kept clean. However, at the present time the equipment allowed by the Quartermaster Department does not permit the issue of a sufficient number of these cans for this purpose, consequently in most cases some other type of food container must be provided.

CANNED GOODS.

Canned goods should be stored in a dry place, preferably cool. The practice of keeping canned goods against the partition back of the kitchen range is objectionable. Every can should be tested at once upon receipt from the quartermaster warehouse to determine whether it is defective or not. All cans that are leakers, swells or springers (r.

pers)[1] should be returned to the quartermaster for credit.

It would be well for the cooks to form the habit of testing the vacuum of every can by knocking it against the table immediately before opening. It will frequently happen that cans which showed no defect in vacuum at the time of receipt from the quartermaster will later become springers. This is especially true of vegetables that have been recently canned but have not had time to develop spoilage when received. It sometimes happens in very hot climates that cans showing perfect vacuums when cool become springers during the intense heat. (See Chapter II, p. 51.)

While canned goods can generally be kept in a cool, dry place, care must be taken to prevent freezing. As in the case of fresh vegetables, freezing does not destroy the food value of canned goods, although it may change the flavor; but marked expansion will take place when the water inside the can freezes and this expansion may produce small cracks along the seams through which bacteria may enter. If such foods were kept after thawing, spoilage might follow as a result of this infection through the cracks. Evidently, therefore, canned goods which have been allowed to freeze should be used immediately after thawing. Another objection to permitting canned goods to freeze is that it is often impossible to distinguish a can that has been distorted by freezing from a springer or swell. There

[1] *For definition* ns see Chapter II, pp. 47–48.

a mistaken idea that it is necessary to store canned ›ods with the top up. The only advantage of this that the label is more easily read.

BREAD.

Bread should be stored in a box specially contructed for the purpose (Fig. 3). It should have capacity sufficient to permit of storing the loaves n end, and it should be possible to separate the esh from older bread, so that the latter may be sed first. Ventilation should be provided by boring few holes which are to be covered by wire netting. t is desirable to avoid excessive ventilation, since his tends unnecessarily to dry the bread and also nakes contamination by dust, germs, etc., more robable. The construction and position of the box hould be such that it can be thoroughly cleaned. t is better not to place it directly on the floor or round, but support it at about the height of a table. Nothing but bread should ever be put in the box, nd it should be cleaned at regular intervals and horoughly dried after cleaning before bread is put n. While the box is being cleaned the bread should e removed and placed on a clean surface or a clean loth and properly covered over until the box is dry nd ready for use again.

CHAPTER IV.

DIGESTION AND ABSORPTION OF FOODS.

THE classification of foods has already been given (Chapter I). The carbohydrates, fats and proteins of foods all possess one characteristic in common—the individual molecules are of large size. Now it happens that the absorptive surface of the alimentary tract is so arranged that only relatively small, simple molecules can be taken up by the body and utilized. The necessity of having the nutritive material actually leave the intestine for the circulatory system may be illustrated: If a hose be laid across a room, entering at one window and leaving by an opposite, and water be allowed to flow through it, then for practical purposes it is correct to say that there is no water in the room; the water inside the hose is not available. So the food passing through the alimentary canal, entering at one end and leaving at the other, is in no proper sense *in* the body at all. Before food can be of any service to us it must be sufficiently broken down or torn apart to pass through the walls of the intestine. The *physical* preparation of food for use by the body begins with the milling of cereals and grain; the cutting and chopping of meats and vegetables; the boiling, baking or frying of foods; and finally ends

with the grinding action of the teeth. Then follows the *chemical* tearing apart of the foods or digestion proper, which may be commenced by the digestive fluids of the body, but which is frequently started outside; examples are the aging (or autolysis) of meats or the action on the starches by heat in cooking, which not only disrupts the cell membranes but renders the starch itself more or less soluble, even to the production of dextrin.

Digestion within the body is concerned chiefly with the proteins, carbohydrates and fats. Water is not changed, and, so far as we know, the vitamines and inorganic salts are not essentially altered before absorption into the blood. The digestion of foods, in the restricted sense, consists in splitting the molecules into smaller fragments by the enzymes in the digestive juices. Thus the final products of food digestion are proteoses and amino-acids from protein; fatty acids and glycerine from fats; simple sugars, *i. e.*, glucose from starches. When digestion is normal and complete the proteins, starches and fats are thus rendered soluble in the digestive juices and absorbable by the living membrane that lines the intestines, and so utilizable by the various organs of the body.

But besides making foods absorbable there is another advantage, particularly as to proteins, in breaking them down. It is well known that the various animals differ in composition and biological reaction, so that the serum of one can act as a violent *poison when* introduced into the circulation of *another. It* would seem that just as Nature fr

on any attempt at interbreeding between different animals, so her jealousy of the purity of kind has caused her to decree that not only the animal as a whole, but every individual protein particle must be true to type. She does not intend that our bodies shall become a zoölogical collection—part beef, part fowl, part fish. Before any protein can be absorbed it must be so broken down as to lose its original characteristics—whether from mutton, eggs, turtle or wheat, the disruptive process must go on until the extraordinarily large, complicated and highly specific molecule of the original protein has become comparatively simple and non-specific. These simple digestive products are then absorbed and rebuilt to form parts of the human body. This process of breaking down and rearranging has often been likened to building a new house from bricks already constituting the walls of some other house. We cannot take sections of the old walls and set them up to form the new; we must first tear down to the individual bricks and then build up with these same bricks the new structure of different design.

THE FIRST STEP IN DIGESTION—COOKING.

Man is the only animal that subjects its food to important physical and chemical changes before eating. The mechanical processes (grinding, chopping, etc.) have already been mentioned. Cooking, however, is worthy of more consideration.

THE ADVANTAGES OF COOKING.—(*a*) Improves *flavor.*

Besides the evident esthetic value, development of agreeable flavor and appearance is distinctly useful as a stimulant to appetite and digestion; a food which is attractive not only "makes the mouth water" but also makes the whole digestive system "water," that is, secrete its juices freely.

(*b*) Mechanically disintegrates the food and partly digests it.

The mechanical disintegration of food by cooking may be quite extensive, particularly in the case of the starches. A familiar example of this is the difference between rice which has been boiled and the grain in its natural condition. The action of heat on starch causes the membrane surrounding the individual starch grains to rupture and the grains themselves to swell so that they are easily attacked by the digestive juices. Under favorable conditions there is also an energetic chemical action, as, for example, in making toast. Toasted bread will contain less starch, some of it having been converted into dextrin; and in bread which has been specially treated by long-continued heat (zwieback) very little starch will remain. This change is, of course, one in the direction of digestion. In the case of eggs, heat causes coagulation which would at first sight appear a step backward. Yet it has curiously enough been found that white of egg which has been slightly coagulated is more readily digestible, and less likely to cause alimentary disturbance (indigestion) than raw egg. Meats appear to form an exception to the rule that cooking aids digestibility, since raw meat is in the test-tube mor

readily attacked than meat which has been coagulated by heat. However, even here the net result of cooking is favorable, since the attractive flavor of properly cooked meat probably does a great deal more to stimulate digestive action than coagulation does to delay digestion.

(*c*) Causes more or less complete sterilization (meat parasites, etc.).

It is well known that meat and fish are liable to be infected by parasites which are capable of taking up their existence in man and producing serious symptoms. The possibility of such occurrence is, of course, completely removed if the meat or fish has been sufficiently heated to kill all animal life. Meat is also likely to contain bacteria or the poisons developed by bacteria capable of producing serious and even fatal illness. All bacteria and many of their products are destroyed by heat. In any doubtful case, therefore, the wisdom of eating food freshly heated is obvious.

(*d*) Permits of readily combining various foodstuffs to produce an essentially new material—for example, a pudding is certainly a different product from any of the materials entering into its composition.

The power of combining various raw foodstuffs, of which there are available only comparatively few, so as to produce an almost infinite number of dishes differing in physical properties, taste and appearance, can scarcely be overestimated. Mixtures of foodstuffs uncooked, remain mixtures; when cooked they become a new product. It is a

physiological fact that a certain amount of change of diet has a distinctly favorable effect, and every-one recognizes the greater zest caused by varied over-monotonous feeding. Cooking is doubtless one of the important steps in the development of civil-ized man. Yet although this art has so long been practised, it is nevertheless true that most persons retain the power of subsisting on raw food.

Although the advantages of cooking are so great, it must not be overlooked that there are also some disadvantages in certain methods of cooking:

First. Loss of soluble materials (soluble proteins, dextrin, sugar, mineral substances) in the water used in boiling.

Second. Impairment or destruction of vitamines.

It is also to be noted that the preliminary mechanical preparation to which food is often subjected is under certain circumstances open to serious criticism. Thus the loss of the antiberiberi vitamines contained in the outer portion of rice grains, removed by polishing, has favored the occur-rence of that disease among peoples depending largely on rice for their nourishment. In the same way, too highly milled wheat is also very objection-able if it be too largely depended upon as a constit-uent of the diet. Again, so simple an operation as the paring of a potato is in a certain sense objection-able in that along with the skin is usually removed much of the peripheral layer of the potato itself, which is the part richest in potassium salts and antiscorbutic vitamines.

DIGESTION IN THE MOUTH.

1. MASTICATION.—Thorough mastication (chew ing) of solid foods facilitates digestion. This is a universal experience, although healthy persons engaged in active physical work, may bolt thei food without noticeable indigestion or malnutri tion. Adequate mastication stimulates salivar secretion and results in thorough mixing of th solid foods with the saliva, which permits a partia digestion of the starches in the food by the salivar enzyme ptyalin. But food is not likely to be wel chewed unless it is palatable; unpalatable food, i eaten at all, is usually bolted. Thorough mastica tion has the following advantages:

(*a*) It facilitates digestion in the mouth an stomach by more complete division of the foo material.

(*b*) It increases secretion of the appetite gastri juice by the more prolonged stimulation of th organs of taste in the mouth and by the increase dilution of the food with the water of the saliva This water, up to a certain limit, favors gastri secretion and digestion.

(*c*) It induces more rapid and complete develop ment of the sense of satiety (fulness) and thu tends to decrease excessive food consumption.

(*d*) It permits more complete sterilization of th foods by the hydrochloric acid in the gastric juice

2. SALIVA.—Saliva is secreted more or less con tinuously, but the secretion is increased when pala table or irritating substances are placed in th mouth, as these su stimulate the sens

nerves in the mouth cavity. The mere thinking of, smelling or seeing palatable (or nauseating) substances may also increase the secretion of saliva ("watering of the mouth"). The secretion of saliva may also be increased in the cases of disorders of the alimentary tract, particularly of the stomach, as in nausea.

The saliva of man contains an enzyme (ptyalin) which acts on carbohydrates in a way to split them down to simpler substances (dextrin and maltose), provided the medium is neutral or nearly so. There is no enzyme in the saliva acting on the proteins or fat. The really important function of saliva is due to the water and mucin which it contains. The water dilutes and the mucin lubricates the food, and flavoring substances are dissolved so that they can act on the organs of taste.

3. APPETITE.—Appetite is in some way related to the mouth and to past experience with the taste and smell of food. Appetite ordinarily presupposes a healthy alimentary tract, an empty or partly empty stomach and a healthy physical constitution in general. These are necessary conditions for the appearance and persistence of appetite. Given these conditions, the memory of the taste and smell of good foods is the first element of appetite, and these memories are intensified and augmented by the actual tasting, seeing or smelling of these foods. This is the basis for the well-known fact that appetite is at first increased by eating.

Appetite for particular kinds of food is a matter *of individual* experience, usually fixed in early

or by long dietary habits, but it may be modi even in adult persons by persistently eating ı foods. Appetite is no reliable criterion for the wh someness or the nutritive adequacy of foods; persistent indulgence in inadequate foods leads malnutrition and a sense of monotony, and tl conditions in some way not only destroy appe for these foods, but induce the opposite sensat of revulsion or nausea. It is a singular fact t serious gastro-intestinal disorders, produced excessive indulgence in good foods or by eat food containing injurious substances, may ind revulsion for these foods lasting for years.

Appetite may be partly controlled by the v This is a point of practical importance in the arı where men from different sections of the count and hence with different dietary habits, must le to mess on the army ration as prepared by ar cooks. One may learn to eat and enjoy new fo or foods prepared in new ways, though they may be attractive when first encountered.

4. THIRST.—The sensation of thirst is referred the pharynx, throat and mouth. Nerves in th regions are stimulated by the condition of dryr of the mucous membrane, due to lessened secret of saliva, resulting from a too great loss of wa from the blood either by sweating or because insufficient water intake. The same condition brought about by eating foods containing much s as the blood tends to become concentrated fr absorption of the salt, as well as by loss of wa n the effort of the kidneys to eliminate the e

of salt. Thirst also develops after hemorrhage or loss of blood, as under such conditions fluids pass from the tissues into the bloodvessels to make up for the loss in blood volume, and the secretion of saliva is diminished.

DIGESTION AND ABSORPTION OF FOOD IN THE STOMACH.

1. Gastric Juice.—There is more or less continuous secretion of gastric juice in the human stomach, so that even in the case of fasting for days the stomach is never completely empty.

When palatable food is tasted or masticated, or when one sees, smells or even thinks of palatable food, when hungry, the secretion of gastric juice is greatly increased provided the person is in good health and the stomach is so empty that hunger is present; but tasting or masticating palatable food does not lead to secretion of gastric juice if there is no appetite. Appetite being present the gastric juice does not start flowing unless the food is palatable.

The rate of secretion of this appetite gastric juice is usually about $\frac{1}{8}$ ounce per minute. The stronger the hunger and appetite and the more palatable the food the greater the secretion. It is not necessary that the food be swallowed to produce the secretion. The *appetite* gastric secretion ceases in most instances within a few minutes after the cessation of masticating the food.

The mechanical contact of food with the lining of the stomach does not cause secretion, but there are substances in some of the foods which, wher

reaching the stomach or the blood, cause secretion of gastric juice through chemical action. These substances are present in meat and meat extracts, or are developed in the protein foods in the course of gastric digestion, hence the importance of meat soups as part of dinner. These soups or bouillons usually contain very little nourishment, but they are valuable in a meal, since they prepare the stomach for proper handling of the subsequent solids of the meal. Thick soups are besides often highly nutritious.

Water itself acts as a stimulant to gastric juice secretion. The drinking of a glass of water or a cup of tea usually induces as much secretion of gastric juice as the eating of a slice of toast. It is thus evident that taking *moderate quantities of water with a meal favors gastric digestion.*

There is a popular but fallacious notion that the so-called bitter tonics and stomachics lead to increased secretion of gastric juice and increased appetite; hence, the common practice of "taking something" for real or fancied digestive disturbance. It is also a common belief among people who habitually take alcoholic beverages that these beverages aid appetite and gastric digestion. Neither the bitter tonics nor the alcoholic beverages are of any practical value in this connection. But they may act by suggestion, *i. e.*, a person may have formed a conviction that indigestion will follow unless these substances are used as "appetizers," in which case the mental disturbance aroused by

meal without an "appetizer" may

res ocesses of digestion.

The most important constituents in the gastric juice are the hydrochloric acid and the enzyme pepsin. Rennin, the enzyme which induces curding of milk, and a trace of fat-splitting enzyme, lipase, are also present in normal gastric juice. Gastric juice, as secreted by the stomach of a healthy individual, contains 0.3 to 0.4 per cent. free hydrochloric acid. This hydrochloric acid is necessary for action of the enzyme pepsin.

When, for any reason, the food remains too long in the stomach the so-called condition of "sour stomach" may develop through excessive secretion of gastric juice or through bacterial action on the foods. This may lead to relaxation of the muscle closing the lower end of the esophagus, so that when the stomach contracts some of the stomach contents regurgitate into the esophagus or mouth, causing so-called "heart-burn."

2. The Digestion of Food in the Stomach.—The left half of the stomach (fundus) acts primarily as a reservoir for the food. Even liquid foods, such as milk, soups or gruel, do not pass directly into the intestines because the sphincter (muscle band) at the junction of the stomach and intestines is usually closed. Some of the food usually starts to enter the intestine in a series of squirts within fifteen to thirty minutes, and this process continues until the stomach is entirely empty of its contents, which takes from two to six hours, depending on the quantity and kinds of food eaten.

The starch foods (bread, potatoes, rice, etc.) leave the stomach *most* rapidly. The proteins (lean meat

white of egg, fish, etc.) are delayed somewhat longer and the fats and oils the longest of all; hence the experience of a tendency to gastric indigestion when eating an excessive amount of fat and the rapid emptying of the stomach and consequent feeling of hunger soon after eating a moderate-sized meal of potatoes, bread or rice. In a healthy adult an ordinary mixed meal of meat, bread, potatoes and coffee should be completely out of the stomach in from three to five hours. A breakfast consisting of moderate amounts of oatmeal, toast and coffee may be out of the stomach within two hours after eating a meal containing large amounts of fat may be delayed in the stomach more than ten hours unless the man is engaged in hard muscular work or exposed to cold. Excessive amounts of fat retard all the gastric functions,—secretion, digestion and contraction.

The important digestive action of gastric juice is on the protein of food by the combined activity of the enzyme pepsin and the hydrochloric acid. The proteins are rendered soluble and gradually split down into smaller bodies called proteoses and peptones, and in this form they pass into the intestine though a great deal of the protein may pass out of the stomach without reaching this stage of digestion, especially if food has been bolted, so that the meat or bread is present in the stomach in big lumps.

There is no digestion of starches in the stomach *except that* carried on by the ptyalin of the saliva *so far as this is* possible, before the entire food ma

has been rendered too acid, the acid in the gastric juice destroying ptyalin. When fat is taken in considerable quantity in the food the delayed emptying of the stomach is accompanied by regurgitation of the intestinal contents (bile and pancreatic juice) into the stomach, so that there may be considerable digestion of the fat in the stomach itself by the combined action of the bile and the enzyme lipase of the pancreatic juice. Otherwise the digestion of fat in the stomach is of minor importance.

It is an interesting fact that gastric digestion is not absolutely necessary for life. There are persons, for example, who have no gastric juice in their stomachs, in which case, of course, there can be no digestion of food in the stomach. Again, in cases of disease, the stomach may be removed entirely by surgical means, the intestine being joined to the lower end of the esophagus or gullet. Such persons remain alive and fairly comfortable for a long time if proper care is taken with the diet in feeding. The disorders accompanying "dyspepsia," "sour stomach," "gas on the stomach," etc., are due to the stomach failing to contract properly rather than to failure in gastric secretion.

The bactericidal action of the hydrochloric acid in gastric juice is undoubtedly of some practical importance. However, substances that pass through the stomach without encountering this acid, such as water, and in some cases liquid foods or solid food particles not penetrated by the acid, will carry whatever bacteria there are in such foods into the intestines.

3. ABSORPTION OF FOOD IN THE STOMACH.—There is under normal conditions very little absorption of foods in the stomach itself. The stomach merely acts as a reservoir passing the partly digested foods gradually into the small intestine. Some mineral substances and poisons (alcohol, alkaloids etc.) are absorbed by the stomach wall.

4. THE MOVEMENTS OF THE EMPTY STOMACH.—It is a singular fact that the empty stomach is not at rest and dilated as one might expect. The empty stomach executes stronger and more continuous contractions than does the filled stomach. The contractions of the empty stomach are similar to those of this organ in digestion, except that they are more vigorous and start at the esophageal end of the stomach, and sweep over the entire organ in periods varying in length from fifteen minutes to two hours, with intervening periods of relative rest varying from fifteen minutes to several hours. When these contractions of the empty stomach are moderately strong they produce on the brain an effect of the "gnawing," "empty" feeling that we call hunger. It is not necessary that the stomach be completely empty before the contractions produce this sensation. The sensation is not produced if the empty stomach is relaxed. If the stomach is completely empty and the contractions are very powerful, the hunger pangs are of really painful character.

Hunger, then, is a sign that the stomach is ready for the reception of another meal. It is not a sign that the organs of the body are really in immediate

need of food, since hunger sets in before the previous meal has been completely digested and absorbed in the intestine. Anything which stops or diminishes these contractions of the empty stomach diminishes hunger. The stomach contractions and the hunger sensation are stopped or diminished by chewing, by swallowing even indigestible material, or they may be stopped by emotional states, particularly those of painful or depressing character. Hence, when a person is going without food for several days the pangs of hunger can be diminished by drinking water freely, by smoking and by vigorously chewing inedible substances, such as pieces of wood.

5. Hunger and Prolonged Starvation.—In prolonged fasting the hunger pangs become associated with a feeling of weakness, and sometimes headache and nausea. These are disagreeable symptoms but in no case do they amount to real suffering unless augmented and distorted by fear and panic. Of course the longer a person goes without food the more he is incapacitated for carrying out vigorous physical work or resisting cold; but every man should know that going without food for days is of no serious significance and certainly not detrimental to health, provided water is available.

6. Hot Foods in the Stomach.—It has been found that the interior of the stomach is not provided with pain nerves. Since, on the other hand, the mouth and throat are quite sensitive, it is a common practice to swallow as quickly as possible any food or drink which the mouth finds too hot to be endured. This habit is to be condemned—

because the stomach does not cry out it would be wrong to infer that no harm is being done: like any other tissue it can be scalded. If the temperature is not so high as to cause discomfort, hot foods are to be commended as more stimulating than cold, as contributing directly a little heat to the body, and because often safer as regards dangerous bacteria or other products. The ingestion of large quantities of very cold food and drink, particularly at the end of a meal, is to be condemned.

DIGESTION AND ABSORPTION OF FOOD IN THE SMALL INTESTINE.

1. Digestive Fluids.—(*a*) *Bile.*—Bile is secreted by the liver more or less continuously, but it is secreted and poured into the intestine in greater quantities during digestion. Bile is both an excretion (or waste) and a digestive fluid of importance in the economy of the body. The continuous secretion of bile is primarily governed by certain chemical substances in the blood. The increased secretion during digestion is brought about by the contact of the acid gastric chyme with the walls of the intestine. Obviously, this stimulation ceases as soon as the stomach is empty.

(*b*) *Pancreatic Juice.*—Pancreatic juice is secreted more or less continuously even in the absence of food in the stomach. The secretion is greatly augmented after eating, the increase beginning when the acid chyme from the stomach enters the small intestine, and gradually slowing down to the rate

of the continuous secretion as the stomach becomes empty.

(*c*) *The Intestinal Juice.*—Certain regions of the upper part of the small intestine secrete a digestive fluid containing several important enzymes. One of these (erepsin) acts very energetically on partly digested proteins, converting them into amino-acids, and the others (invertase, lactase, maltase, etc.) act on the carbohydrates of the food, such as cane sugar, milk sugar and maltose, splitting them into the simple sugars, dextrose, galactose and levulose.

2. Digestion and Absorption.—Bile hastens emulsification and digestion of the fats by a ferment in the pancreatic juice and probably also aids in the absorption of the fats by the intestinal mucous membrane, but it is not absolutely necessary for digestion. The disorders of digestion that may accompany so-called "biliousness," and "sluggish liver" are usually due to impairment of the alimentary tract, not to depression of the liver—in fact, have nothing to do with the liver.

Pancreatic juice is the most important of the digestive fluids, as it contains enzymes that act on the three foodstuffs, proteins, carbohydrates and fats, splitting them so that they can be absorbed and utilized by the body. The enzyme acting on the proteins is called trypsin. This enzyme differs from the pepsin of the gastric juice in that it acts in a neutral or alkaline medium. The enzyme acting on the fats is called steapsin, and that acting on the starches of the food is called amylopsin.

By the combined action of the fer

pancreatic juice and the intestinal juice, reinforced by some of the constituents of the bile, the foods undergo a relatively complete digestion in the small intestine, so that in the normal individual they are practically completely (90 to 98 per cent.) digested and absorbed by the time the intestinal content reaches the large intestine. The small intestine is therefore the most important organ of digestion and absorption.

3. THE MOVEMENTS OF THE SMALL INTESTINE DURING DIGESTION.—In health the food mass requires two or three hours to pass the entire distance from the stomach to the large intestine. The forward movement of the intestinal content is due to peristaltic contractions very similar to those of the stomach. These contractions do not sweep over the entire length of the small intestine, but pass over a short distance at a time, so that the food mass is forced forward in steps. When the peristaltic wave ceases, local contractions occur, pushing the food backward and forward for some time. Then a new peristaltic wave occurs which carries the contents a few inches farther on. These processes (peristaltic contractions and segmentation contractions) are repeated until the fluid mass reaches the large intestine. The two types of movement described are admirably adapted to the role of the small intestine, viz., complete mixing of the food with the digestive juices, with time for digestive a[illegible]n and for absorption of the end products [illegible]testinal contractions go on inde[illegible]ne[illegible] [illegible]ey are profoundly

modified and depressed by emotional states, such as fear, anger, anxiety or depression, as well as by intense mental and muscular exertion. From what has been said it is clear that when men are engaged in hard training the heavy meal should be served at the close of the day.

DIGESTION AND ABSORPTION OF FOOD IN THE LARGE INTESTINE—DEFECATION.

1. ABSORPTION.—The large intestine is about four feet in length and has considerable capacity. The principal role of this part of the intestinal tract is the absorption of water and such digestive products as have escaped absorption in the small intestine. In this way the bulky and watery mass is rendered solid or semisolid before being eliminated from the body. There is no secretion of digestive fluids by the lining of the large intestine, but digestion of foods is continued by the pancreatic and intestinal enzymes and by the action of bacteria.

2. MOVEMENTS.—The movements of the large intestine are less regular than those of the stomach and the small intestine. They are of several types. Antiperistalsis consists of waves of contraction which pass toward the small intestine, *i. e.*, backward. These movements tend to keep the liquid mass back, thus allowing time for more complete absorption of the water; but in the normal individual the contents are not actually forced back into the small intestine because of the action of the *valves at the* junction of the small and the large *intestine* (ileocecal valve). Antiperistalsis

nates with strong contractions sweeping in the opp site direction, tending to carry the mass toward tl descending colon and the rectum.

3. DEFECATION.—Evacuation of the bowel started by irritation by the fecal matter, of nerv in the lining of the rectum, which produces a co scious desire to evacuate the bowels and also ten to relax the external sphincter, the strong musc at the end of the rectum. This sphincter musc is partly under voluntary control, so that a pers can for a time overcome the efforts of the rectu In the normal individual the mass of food débi and indigestible residue remains in the large inte tine from ten to twenty hours. It should not rema longer than twenty-four hours.

4. CONSTIPATION.—Constipation is of two type One type is due to lack of tone or contractions in tl musculature of the bowel, which results in gre relaxation or distention of the bowel, so that it ca retain the food débris for days (or in some cas for weeks). The second type of constipation is d to excessive tone or contraction of the bowel mu culature, gradually reducing the capacity of t gut, but at the same time not permitting the norm forward peristalsis that carries the fecal matter the rectum. In this type of constipation the fo mass tends to become excessively dry and hard a separated into small boluses or pellets.

Constipation leads to a number of injurious effe in the individual. These are due to two caus namely: (a) Absorption of poisonous materials d o excessive bacterial action in the stagnating

mass ("auto-intoxication"), and (*b*) chemical and mechanical irritation of the nerve endings in the intestine by the stagnated food mass. Both these factors work in the same directions to produce harm. They may cause abdominal discomfort, headache, depression, nervousness, etc. When constipation becomes chronic it may lead to more serious derangements of the health. It has a bad effect on other parts of the gut, depressing both digestion and motility in the stomach and small intestines, giving rise to abnormalities of both secretion and absorption. Constipation is unfortunately quite common, owing to faulty dietary habits and abnormal modes of living. The most important measures to counteract constipation are the following:

(*a*) *Roughage.*—Roughage is the indigestible material in foods. An adequate amount of roughage in the food is essential, so that when the digestive enzymes have completed their work and the digestible parts are absorbed, there will still be left sufficient bulk or débris to furnish mechanical stimulation to maintain intestinal motility. Such roughage is present in the form of cellulose in vegetables and in fruits, in the coverings of grains, in cartilage and bones, etc., and by the modern processes of food preparation a great deal of this normal roughage in the food is removed. It is unlikely that anyone will consume too much roughage in the food.

(*b*) *Habit.*—The formation of regular habits in evacuating the bowels is as important as an adequate amount of roughage in the food. The eva

tion of the bowels should occur at least once in twenty-four hours. Unless the desire to defecate is promptly carried out the contractions of the bowel and the rectum cease, the muscle relaxes and the impulse may disappear for hours. If this habit is persisted in for any length of time there appears to be a gradual loss of sensitiveness of the nerves so that the presence of fecal matter does not lead to the desire for evacuation. In this way the nervous or careless individual, forgetting or ignoring the fact that it is more important to have regular hours for evacuation of the bowel than to have regular hours for eating, may gradually train his alimentary tract to sluggishness.

(*c*) *Muscular Work.*—Adequate physical exercise, preferably in the open air, is the third important element in maintaining regularity and proper evacuation of the bowels.

INTESTINAL BACTERIA AND DIGESTION.

1. Shortly after birth bacteria enter the digestive tract through the mouth of the infant and remain there throughout life. These normal inhabitants of the alimentary tract are not to be confused with the bacteria that cause specific diseases, such as typhoid fever or dysentery. In the healthy individual, living on normal diet, the bacteria of the alimentary tract are probably not appreciably *injurious.* They are to be looked upon as relatively *harmless parasites,* even under some conditions *beneficial, although* they may become markedly

harmful under conditions of improper feeding or impaired digestion.

2. In health the chemical changes produced by these organisms on foodstuffs are essentially identical with those induced by the digestive enzymes; but in the case of the putrefactive bacteria the amino-acids are split into products that cannot be utilized by the body and in some cases the products are distinctly harmful. Therefore, marked activity of the putrefactive bacteria in the alimentary canal represents waste of food and production of poisons.

Putrefactive bacteria do not flourish in the acid medium produced by the organisms which act primarily on carbohydrates; and since the latter group predominates in the stomach and small intestine in the normal person, there is little or no putrefaction in these regions of the alimentary canal. The putrefactive bacteria predominate in the large intestine, and their activity depends on the amount of protein that has escaped digestion in the stomach and small intestine as well as the stagnation of the contents in the large intestine (constipation).

3. Thus, eating an excessive amount of protein, or eating a moderate amount when the stomach and intestines are for any reason impaired may favor excessive and injurious activity of the putrefactive bacteria. Poorly prepared foods or an ill-balanced diet may act in the same direction. For example, an excessive quantity of fat in the food may lead to a coating of fat surrounding small fragments of meat in the stomach, which will retard the action of the enzymes to such an extent

some of the meat may pass through the tine without being digested. This is importance to the mess officer, as exce ness of foods is one of the commone: army cooking. It cannot be too often that the human stomach and intestines factorily handle excessive quantities c food except in very cold weather or w are doing extremely hard physical labo amounts of fat are not needed in the under those conditions.

HYGIENE OF DIGESTION.

The American soldier is in the prim should be in the best of health, as th and mentally unfit are ordinarily ex service. The fit man may, *for a time*, t laws of dietetics and digestion with a punity. Nevertheless, attention to t points will contribute to his health, ha efficiency:

1. Regulate the quantity and kind c according to the climate and the wor warm weather and when doing little mu eat less meat and much less fat. In c coupled with hard work, a large amount fat may be handled by the body, al then the requirements may be met l *foods. When* doing hard work in wa *eat cereals, vegetables* and a minim *and fat.*

2. Eat an abundance of fresh vegetables whenever obtainable. Some vegetables or greens, when they can be obtained *from a safe source*, should be eaten without cooking.

3. Use fresh milk and butter wherever possible. Milk supplies all classes of nutrients (besides containing vitamines) and is palatable to men with the most diverse dietary habits; it thus contributes to the feeling of contentment and satisfaction, which is so important for good digestion.

4. Take plenty of water with each meal. This aids gastric digestion and intestinal absorption. The water and food should not be taken together; that is, the food must not be washed down; the tendency would be to slight the chewing process.

5. If hunger and appetite are lacking it is usually an indication that the gastro-intestinal tract is not prepared to take care of the food, and one should eat sparingly or nothing at all. Feeding under those conditions is more injurious than fasting.

6. A soldier should have his three square meals a day, but he is also able to go without them for short periods if necessary. In going without food he will lose about one pound per day of his body weight, but this is no reason for losing his head or his courage. If water is available the discomforts of fasting for a few days are negligible unless distorted by fear and panic.

7. Maintain as regular a habit in the evacuation of the bowels as in the eating of meals; the former is as important a function as the latter.

8. Avoid too intense mental or physical work

immediately after a large meal, as such activities impair or delay digestion and absorption.

9. Good digestion requires the cultivation of good cheer. Strong emotions, depression and melancholia retard the functions of the alimentary tract.

10. The nutritive value of foods is not always indicated by their taste and flavor. Hence, do not hesitate to serve or consume foods that have not the flavor or seasoning to which your individual palate has been accustomed in the past, provided they are wholesome.

CHAPTER V.

NUTRITIVE VALUE OF FOODS AND THEIR USE IN THE DIET.

WHOEVER undertakes to arrange a diet suitable for any group of individuals, especially if he must exercise economy in the use of the means at his disposal, should have some knowledge of the simple principles of nutrition. It is not sufficient merely to provide good food and plenty of it. Food materials of the best quality could be combined into generous and palatable meals that would not supply proper nourishment because of the lack of substances that are absolutely essential to the body in maintaining health and strength; or they might supply all of the essential ingredients but cost more than necessary. Neither of these conditions is important in a single meal, but as a regular practice, might lead to serious physiological or financial disturbance. It can easily be avoided by anyone who understands what the body really needs, and how these needs can be satisfied by the ordinary food materials.

Many of our common food materials comprise both edible and inedible portions. The inedible material, such as the bones of meat, shells of eggs and skins and seeds of vegetables and fruits, which are commonly termed refuse in discussing the

portions of foods are considered chiefly wi
to the edible portion of food materials. Th
discussion of the nutritive value of foods i
account only the edible substance.

The edible portion of ordinary food
such as meat, bread and vegetables, cont
water and solid substances. The presence
is shown by the loss in weight of the sub
moderately high temperatures. At still hi
temperatures the dried substance will burn,
residue of non-combustible material or a
chemical analysis the combustible materia
to be composed of compounds called carbo
and fats, in which the elements carbon,
and oxygen are present in different comb
and protein, in which in addition to these
are nitrogen, sulphur and phosphorus.
commonly called organic compounds.
combustible material or ash consists o
compounds of the so-called mineral or
elements, the commonest among them, in
to sulphur and phosphorus already mentio
chlorine, calcium, magnesium, potassium
and iron. The value of food to the body
mainly upon the ingredients mentioned, bu
tion to these there appear to be other very
constituents called vitamines, the chemica
of which has not yet been ascertained. T
ciples of nutrition are based upon a know
the ways in which the body utilizes all
constituents of food

FOOD AS A SOURCE OF ENERGY.

Food is sometimes called the fuel of the body. 'he expression is quite appropriate because the ody is virtually a device for doing work, and like ny mechanical device for this purpose must be upplied with power with which to do it, or, in other vords, with energy. The body also uses energy in producing heat to maintain its temperature. Food s the source of energy to the body just as coal is the ource of energy to the steam engine. The energy of food or of coal is known as potential energy and that of work as kinetic energy. Heat is also kinetic energy. In doing work or in producing heat, therefore, the body is converting the potential energy of ood into kinetic energy and in the process combustible material supplied by the food is literally burned just as coal is burned in the furnace; that is, ts carbon and hydrogen are combined with oxygen and the oxidation results in heat. The process of oxidation is slower in the body than in the furnace, ience the heat is less intense, but the amount of ieat produced by the combustion that occurs is exactly the same as that which would be produced f the same material were burned outside the body.

The amount of heat that a given amount of any ort of food will yield by being completely burned s known as the heat of combustion and is taken as measure of the total potential energy of the food. t can be determined in an apparatus called a alorimeter by burning a weighed sample of the od in such manner that all the heat generated imparted to a known volume of water and r

the increase in the temperature of the water. The result is expressed in calories, the term calorie being used to indicate quantity of heat just as the term pint is used to indicate quantity of water. One calorie is the quantity of heat that will raise the temperature of very nearly one pint of water 4° F., or, more accurately stated, that of one liter of water 1° C.

The number of calories which the body would obtain from a given amount of any food material is called the fuel value of the food material. This is less than the potential energy determined, as explained above, for two reasons: in the first place a small part of the protein, fat and carbohydrate of the food would not be digested and absorbed; and in the second place the absorbed protein is not quite completely burned in the body. In determining the fuel value these losses must be taken into account. The fuel value of a food material is commonly calculated from its chemical composition by the use of factors for the fuel value of its protein, fat and carbohydrates, which have been derived from the heats of combustion of these substances by making allowance for losses in digestion and for the part of the protein that is not burned in the body. The commonly used factor for the fuel value of both protein and carbohydrate is 4.1 calories per gram, or 1860 calories per pound; and that for fat is 9.3 calories per gram, or 4218 calories per pound.

The combustible materials supplied by the food are oxidized in the small units called cells, of which body tissues are composed. The complex com

pounds protein, fat and carbohydrate of the food eaten are reduced by digestion to simpler substances that may be absorbed from the intestines, and these are carried by the blood to all parts of the body for the use of the cells. At the same time oxygen taken into the blood through the lungs is carried to the cells to support combustion. The body is continuously burning its fuel material in doing muscular work and in producing heat to maintain its temperature. Unless this temperature is maintained within quite narrow limits the tissues will cease to perform their functions and the body will die. Heat is constantly lost from the body to the air and to other objects with which it is in contact and by evaporation of water from the lungs and skin, and unless this loss were made up the temperature of the body would fall. In ordinary circumstances the heat resulting from the activities of the body suffices for this purpose. The greater part of the energy expended by the skeletal muscles in doing mechanical work, by the heart in keeping the blood in circulation, by the diaphragm in respiration, by the stomach and intestines in peristalsis, as well as by the cells of all active tissues in performing their functions, is converted into heat, which can be used by the body in maintaining normal temperature. In some circumstances, as in cold weather, when the body is inactive or insufficiently protected by clothing, the cells may be stimulated to greater activity, as in shivering, to produce more heat for the purpose of maintaining body temperature.

Since all the energy expended by the body ca

converted into heat and the body has no other source of energy than its food, the amount of energy that must be supplied in the food has been ascertained by measuring the heat produced by the body in different circumstances. The amount necessary for any individual has been found to depend on his age and size, the temperature of his environment and his muscular activity, especially the latter. An active well-fed young man of average size in good health would liberate heat to the amount of 1600 to 1800 calories in twenty-four hours if he spent the whole of the time asleep in bed, protected against any cooling effects of the atmosphere. This would be his minimum or basal requirement of energy. If he were lying awake his heat output would be slightly higher, and if he were sitting it would be still higher. If the man should eat his meals during the period his elimination of heat would be increased, both because of the muscular effort involved and because the digestion products taken into the circulation increase the rate of combustion and stimulate the production of heat in the body. With every increase in muscular activity the transformation of energy would increase. If the man were engaged part of the day at work which involved only slight muscular effort his heat output for the day would be about 2500 calories. If his work were equivalent to that of a carpenter, a mechanic or a farmer his energy expenditure would range from 3000 to 3500 calories according to the amount of work he did. The soldier in active training in the camp... United States not unc

monly expends as much as 4000 calories of energy in one day during the winter months and somewhat less in the summer months, and this amount of energy should of course be available to him in his food.

It is not necessary that each day's diet shall supply the exact amount of energy expended during that day, because the body can adapt itself to a considerable variation in its supply. If the fuel value of the food is not sufficient for its immediate needs the body will burn its own material to make up the deficiency. Naturally this could not continue indefinitely. On the other hand, if the food supplies more energy than it needs, the body will change the surplus material into fat to be stored for later use. It is interesting to note that the excess of the diges-ion products from the proteins, fats and carbo-hydrates are all converted into body fat, which is a source of fuel. The fuel value of the diet for adults should be just sufficient to prevent a continuing ncrease or decrease in body weight.

The greatest need of the body for food results from his requirement for energy. The proteins, fats and arbohydrates all serve as a source of energy, but n the average diet by far the larger part of the nergy is supplied by fats and carbohydrates, which re often called the fuel ingredients of food. In a vell-chosen diet carbohydrates would supply 60 to 5 per cent. of the total energy. They are the most conomical food ingredients for this purpose, and e body *can utilize* their energy much more readily *an it can that* of the other ingredients. Th *ticularly true* of sugar. The fats in such

would supply about 20 to 25 per cent. of the energy ordinarily, though in some instances, when slow digestion is desired, so that the food will "stay by one," more fat may be used. The protein of the diet should supply not more than 10 to 13 per cent. of the energy. This is the most expensive part of the food, and there are disadvantages in eating too much protein. These will be considered later. In some instances, as in exposure to cold, there may be an advantage in an abundance of protein in the diet, because it increases the production of heat by the body.

FOOD AS A SOURCE OF MATERIAL FOR BODY TISSUE.

Food is more than a source of energy to the body; it must also supply what materials are needed to form various tissues and fluids, such as blood and muscle, bone and tendon, brain and nerve. These materials are necessary not only for growth but also for repair. Active tissues use up some of the materials of which they are constructed, and those losses must be compensated. The greatest loss is of protein, which is the chief structural substance of tissue, but there is also loss of mineral matter. A very small portion of this mineral matter comes from the breaking down of the protein tissue, but most of it comes from other tissues, as calcium, magnesium and phosphorus from the bones and iron from the blood.

Body proteins are produced from food proteins. Familiar examples of food protein are myosin of meat, gluten of wheat, casein of milk and album

of egg. These substances do not enter as such directly into tissue structure, but are first converted by digestion into less complex components which can be taken into the blood through the walls of the intestine and carried to all parts of the body, to be used by the different tissues for recombination into the specific proteins characteristic of their structure. The products resulting from the complete digestion of protein are known as amino-acids, of which there are at least eighteen different sorts, varying considerably in their importance to the body in its formation of tissues. There are appreciable differences in kinds and quantities of amino-acids combined in different tissues. It is not necessary that any food protein shall supply them all, because the body is able to convert some of those that are provided into others that it may need, but which are lacking in the protein of the food. On the other hand, several that are absolutely essential to the body must be present as such in food protein. Any protein that fails to supply them does not suffice for adequate nourishment, at least during growth, though it may be sufficient for repair of tissue in the adult. Food proteins differ materially with respect to the kinds and amounts of amino-acids which they supply. Very few of them yield all of the essential acids, at least in amounts sufficient for body requirements. The proteins of meat, milk and eggs are superior to those of other food materials in this respect. None of the common cereals such as wheat, oats, corn or rye contains protein that alone adequate for proper nutrition. The pr

of potatoes seems to be more nearly so than tl
of the cereals. To ensure a sufficient supply of
essential amino-acids the diet should includε
variety of food proteins, both animal and vegetal

When the variety is sufficient a moderate amoı
of protein will satisfy the actual needs of the aver
man in good health. In the well-nourished ad
body the increase in tissue that occurred dur
growth has ceased, and, if the diet supplies a sι
cient amount of energy, the breaking down of tis
protein due to activity of the cells is relatively sm
Contrary to the belief of many people, muscι
exertion has little, if any, effect upon the loss
protein. The theory that men doing heavy wı
need a great deal of protein food, *i. e.*, of meat
both a mark of ignorance and a cause of mı
waste, and perhaps even of ill health. The amoı
of protein loss does vary, however, depending
some extent upon the individual and upon
amount of food supplied. If one were fasting,
living on a diet supplying sufficient energy, but li
or no protein, his daily loss of nitrogenous substa
might be as small as 20 grams—less than 1 our
This is an abnormal condition. The average dε
loss of tissue protein by individuals in ordinary
cumstances does not, however, commonly exc
50 grams, or a little less than 2 ounces. To repl
this amount of protein in the body would reqι
about 55 grams, or nearly 2 ounces, of protein
the food, because some of it would escape digesti
To provide a residue for normal fluctuations
lemand, a well-chosen diet should include

protein than the actual minimum requirement; but since the body does not store protein it is not advisable to eat large quantities of this expensive material. Statistics concerning the diets of a large number of American families show an average daily consumption of a little more than 100 grams, or $3\frac{1}{2}$ ounces, of protein per man. The diet of the soldiers in the United States Army camps supplies on the average 120 grams, or 4 ounces. These amounts are probably larger than are required for all ordinary needs. In some circumstances, as, for example, in very cold weather, as previously mentioned, a generous supply of protein may be of some advantage because of its effect in increasing heat production; but this is also a reason for avoiding an excess of protein at other times, especially in hot weather. Another reason suggested is that it makes unnecessary work for the kidneys. The protein that is not used for the formation and repair of tissue is broken up by the cells into two portions, one of which may be oxidized or converted into fat; the other, which consists chiefly of urea, cannot be used by the body for either of these purposes and must be eliminated. The quantity of protein ordinarily consumed probably does not tax the capacity of the kidneys to perform their functions.

In selecting the diet to meet the needs of any individual, if care is taken to include a variety of animal and vegetable foods, the combination that is found sufficient to supply the necessary amount of energy will probably also furnish the requisite sorts and amounts of protein.

The fat of the diet is also used to some extent in the formation of tissue. This does not refer to the deposits of fat under the skin known as adipose tissue, but to the actual combinations of fats and of compounds derived from fats with protein in the protoplasmic substances of cells, in cell membranes and in the tissues of the central nervous system. So far as is known no particular kind of fat is essential for this purpose. All of the fats of the food are split by digestion into components called fatty acids and glycerine, which are capable of passage through the membranes of the intestinal wall, and these compounds are recombined into the neutral fat, which the blood carries to the tissues to be burned as fuel for present needs, or stored as fuel for future needs or used in the formation of tissues. The amount of fat required for this latter purpose is not large; any ordinary diet that furnishes a sufficient amount of energy for bodily needs, with 20 to 25 per cent. of the energy supplied in fat, will provide ample fat for the tissues.

A kind of carbohydrate called glycogen is present in the tissues in quite constant proportions under normal body conditions, though in different proportions in different tissues, being most abundant in the liver. It is not, however, a constituent of cell structure as protein is, but is a reserve source of energy to the cells, which convert into glycogen the glucose they take from the blood in excess of their immediate needs for energy. The blood normally contains a definite proportion of glucose derived from the digestion of starch and sugars, which are chang

:o glucose, fructose and galactose in the intestine. Products of carbohydrate digestion (chiefly glucose) absorbed from the intestines are carried to the liver and stored there as glycogen, which is converted again to glucose and supplied to the blood as needed to restore the normal proportion of carbohydrate as it is taken out of the blood for use by the cells.

At least twelve different mineral elements are found in the tissues and fluids of the body and must be supplied in the food; some of these, however, are concerned more with the regulation of body functions, discussed in the next paragraph, than with the building of tissues here considered. Under ordinary conditions of diet and health the average man excretes 20 to 30 grams, a little less than 1 ounce, of mineral substance each day. A very small part of this loss results from the disintegration of protein; a larger part is from the other constituents of the tissues and fluids. The elements excreted in greatest amount are calcium, magnesium, sodium, potassium, chlorine, sulphur, phosphorus and iron. None of these can be said to be of more importance than the others, because a persistent deficiency of any of them would result in serious loss of health or even death. Any ordinary combination of food materials that is adequate with respect to protein and energy will probably supply all the essential mineral elements in sufficient amounts, though unless care is taken to prevent it there may be a deficiency of calcium, phosphorus and iron. If milk, vegetables and fruits re *used abundantly* these elements will not be *cking.*

FOOD AS A SOURCE OF REGULATING SUBSTANCES.

Some of the elements that are present in the tissues and fluids of the body, such as chlorine, sulphur and phosphorus, are acid in character; while others, such as calcium, magnesium, sodium and potassium are basic or alkaline. Acids and bases when brought together in right proportions tend to counteract each other by combining to form compounds that are neutral, that is, neither acid nor basic in character. In normal conditions in the body the acid and basic elements are present in such proportions that the tissues and fluids are approximately neutral or slightly alkaline. Food materials should be selected, then, so that there will be sufficient of the basic elements at least to neutralize those that are acid. An excess of the basic elements sufficient to produce an appreciably alkaline condition would not be injurious, whereas a long-continued excess of the acid elements might be very harmful.

An excess of protein in the diet tends to reduce the alkalinity of the body fluids because the products resulting from the use of protein by the body are acid in character. This is another objection to the use of too much meat or other protein-rich foods. The residue from some of the other food materials, as the cereals, is also acid, whereas that from most fruits and vegetables is basic. An abundance of vegetables in the diet is therefore always desirable. The wisdom of such combinations as meat and vege- [illegible] is thus illustrated. Though milk is classed

as a protein food it contains basic elements also to such an extent that its residue is weakly alkaline, hence milk needs no other food to balance it in this respect.

To a certain extent the carbohydrates also serve in maintaining and regulating body functions. If the diet lacks carbohydrates the body does not oxidize fat completely, and the result is the formation of an acid that accumulates in the body. The total quantity of carbohydrate necessary for maintaining the normal conditions in the body is so small in all ordinary circumstances that it need not be taken into consideration in the selection of a diet, because carbohydrates are the most abundant ingredient in the diet.

A diet that satisfies all the needs of the body for protein, fats, carbohydrates, mineral substances and energy may still be inadequate because of the lack of certain components called vitamines, having properties different from any hitherto considered. Little is known of the chemical nature of these substances, but the effects of a deficiency of them in the diet are well established. There are known to be two different kinds of them, having quite different properties; and there may be more. The disease known as scurvy, which afflicts men who have lived for a considerable period on salt meats, canned goods, dried fruits and vegetables and hard bread, is usually thought to be due to the lack of vitamines; it is cured by adding to the diet such food as fresh meats and milk and fresh fruits and vegetables which contain vitamines. These substances are

present in a large number of foods in their natura conditions, but are more or less destroyed by heat ing and drying. They are lacking in unleavene bread, but are found in bread raised with yeas because abundant in yeast itself. They surviv the temperature at which some foods are cooked for instance, the vitamine of potatoes is no destroyed by boiling. Antiscorbutic vitamine i developed in beans and perhaps in other seeds i sprouting.

The disease known as beriberi, or polyneuritis which affects tissues of the nervous system of per sons fed largely or wholly on polished rice, is als due to a lack of vitamine, and is cured by the addi tion of rice bran, in which the vitamine is present The water extract of the rice bran is sufficient t cure the disease in animals. Because of their solu bility in water this class of substance has beer designated "Water-soluble B."

Another substance, known as "Fat-soluble A because it is found dissolved in some fats, is al essential for normal nutrition, especially durin growth. Food that is deficient in this substan will not support growth in the young, and ev adults on a diet of such foods would not keep good health nor recover properly from disease injury. How much of this substance the b actually needs is not known. The amount requ by men in health is small, but must be containe the food materials. Larger amounts are neces for growing individuals or those recovering sickness or wour The quantities prese

different food materials are not known, but it is known that this substance is most available in the fats of milk (butter fat) and eggs. It is found in some other animal fats, but not in vegetable oils. Either this substance or another with similar properties has been found in some plant tissues, such as spinach, dandelion, turnip greens and lettuce. This is another illustration of the necessity for variety of animal and vegetable food in the diet, and particularly including fresh vegetables and fruits.

Water is also essential to the body in maintaining normal functions. Not only the fluids but also the tissues contain large proportions of water, which is responsible for nearly three-fourths of the weight of the body. It is constantly being eliminated from the body in excretions, in perspiration and in expired air. Practically all the food materials as eaten contain more or less water, but liquids drunk form the chief source of supply to the body. It should be freely consumed, any excess over the amount needed to maintain normal conditions of the fluids and tissues being readily eliminated. The amount taken with food at meals should be generous, because it has a favorable influence on the action of digestive juices in the stomach, though it should never be used to wash down food not sufficiently masticated.

A diet of meat or milk and bread made of fine flour, or any other combination of food materials that contain little indigestible material, may result in constipation, with disorders attendant upon retention of the feces. Considerable assistance in over-

coming such a condition and maintaining normal action of the intestines results from including in the diet the fiber of vegetable material called cellulose which is not readily digested in the human intestine. This gives bulk to the intestinal contents and stimulates the peristaltic action, by which they are moved along through the digestive tract. Since evacuation of the bowel is of much importance in the preservation of health, particular attention should be given to means of inducing and regulating such action. This may generally be accomplished by adding to the diet sufficient quantities of vegetables and fruits.

THE VARIOUS CONSTITUENTS OF THE DIET.

Any substance to be considered as food must satisfy at least one of the requirements described in the preceding pages. None of the ordinary food materials alone constitutes a satisfactory diet. Different sorts of food differ widely in the kinds and proportions of nutrients they contain. The problem of planning an adequate diet therefore consists in combining a variety of foods in such manner that the body will be supplied with all the essential kinds of material in the proper proportion. This involves some knowledge of the fuel value and chemical composition of foods, at least sufficient to classify them as sources of protein, fat, carbohydrate, mineral matter and bulk. A table showing the composition of foods in use in army camps is given in Chapter I.

The food materials in common use comprise five

different gr[illegible] or classes, according to the purpose they chief[illegible] in supplying the body with nutrients and [illegible]paration of palatable meals, viz., meats a[illegible]stitutes, cereals, vegetables and fruits, [illegible]ts. A healthful and palatable diet c[illegible] by combining material from each [illegible]n the meals for each day. An [illegible] doing eight hours of moderate [illegible]h day, such as a carpenter or [illegible] adequately nourished if his diet [illegible]rials from these groups in the following portions:

[illegible] and meat substitutes		14 ounces.
Meat, fish, eggs, cheese, etc.	8 ounces	
Dried legumes	2 "	
Milk	4 "	
Cereals		12 ounces.
Flour	9 ounces	
Other cereal	3 "	
Vegetables and fruits		20 ounces.
Potatoes	14 ounces	
Other vegetables	4 "	
Fruits, dried	2 "	
Fats		3 ounces.
Bacon or salt pork	1 ounce	
Butter, lard or substitute	2 ounces	
Sweets		3 ounces.
Sugar	1½ ounces	
Sweet foods equivalent to sugar	1½ "	

If food materials of average quality and composition are used these amounts would supply approximately 100 grams of protein and 3500 calories of energy. A soldier undergoing active training expends about 15 per cent. more energy and needs at least 4000 calories. This 15 per cent. add

food should be derived from the groups given above in similar proportions as given for a carpenter or mechanic.

MEATS AND MEAT SUBSTITUTES.—The group of meats and meat substitutes includes beef, mutton and pork, poultry, fish, eggs, milk, cheese and the dried legumes, beans, peas and lentils. The chief importance of this group of food materials is to supply protein. More than one-half of the protein of the diet is derived from the foods of this class. The larger part of the remainder is supplied by cereal foods and the rest by vegetables. The protein of the animal foods is commonly considered to be more valuable than that from cereals or vegetables, because it is more easily and more completely digested and is believed to be more available to the body for the building and repair of tissue, since it is more nearly like human tissue proteins. The most important difference economically is in the thoroughness of digestion. The protein of animal foods is almost completely digested, whereas about one-eighth of the protein of the cereals and one-sixth of the protein of the vegetables escapes digestion because it is encased in cellulose.

In this country beef is used in much larger quantity than any of the other meats, but probably because the majority of people consider it more palatable and not because it is more nutritious or richer in protein. The ordinary cuts of mutton and pork are so similar in composition to those of beef that they may be used interchangeably as sources of protein.

Fish has much the same proportion of protein as meat. It contains somewhat more water, and most fish contain less fat and are therefore less economical than meat at the same price per pound. Whenever the price warrants it, however, fish may be used in place of meat as a source of protein. In many localities it is sold at a price that warrants much larger use of fish than is common.

Milk is an economical source of protein as compared with meats. A quart of milk will replace one-half pound of meat in this respect. The 14 ounces of meat and meat substitutes suggested above is intended to include at least 4 ounces of whole milk or its equivalent, about 2 ounces of evaporated milk. Skimmed milk and buttermilk are as valuable sources of protein as is whole milk, but should be obtained at lower prices, of course, because of the removal of the fat. The milk prepared by dissolving milk powder in water, as suggested on page 39, can be used in the same manner as the original milk; while in the preparation of many cooked foods the powder may be used without first dissolving.

Cheese is about one-third richer than meat in protein and would accordingly be a more economical source of protein at the same price per pound; when made of the whole milk it is also richer in fat than most meats. A dish of macaroni and cheese, with some vegetable food to furnish bulk and mineral matter, is therefore a very good meal. Many other dishes equally palatable can be made with cheese and other cereals and vegetables, and should be frequently used. Cheese can be included in the diet

in such quantities as to serve as the chief source o protein without causing any disturbances such a are sometimes attributed to it. Cottage cheese als is worthy of consideration, having practically th same proportion of protein as meat. Any sour mil accumulated might profitably be used, therefor to make cottage cheese.

The dried legumes are included in this grou rather than with the vegetables because they ar especially rich in protein; in fact, they are th cheapest source of protein in the diet. The tot amount of legumes used should be equivalent t not less than two ounces of common white bea per day, and even more than this can be used i place of some of the meat. Besides the white o navy bean, there is a considerable number of other such as the black, kidney, pinto, lima and Chi beans, which might be included for the sake o variety. The bean known as the field pea or co pea, which is abundant in the Southern States, worthy of wider use.

CEREALS.—The cereals eaten in largest amoun are wheat, rye, corn, oats and rice. They diffe materially in the ways in which they are used, bu are quite similar in one respect; nearly three-fourt of the nutritive material in all of them is starc which the body uses as fuel. The quantity of fa in all of them is small, being largest in oats and corn They contain a fair amount of protein, howeve over 10 per cent. on an average; and becau *cereals comprise* such a large part of the food eate *they supply about* 40 per cent. of all the prote

in the diet. The starch of all the cereals is almost completely digested, but a considerable part of the protein escapes digestion, especially in the coarser cereal products, because it is combined with cellulose. It is more thoroughly digested in the finer flours from which the bran has been sifted. When the diet does not contain an abundance of vegetables and fruits it is wise to use the coarser flours and meals, which include the bran, because this part of the grain contains essential mineral matters and vitamines that might otherwise be lacking from the diet. The bran also compensates for the lack of vegetables by providing bulk and stimulating the action of the intestines.

Wheat is used in larger amounts than any of the other cereals because of the variety of ways in which it can be prepared, and particularly because it can be made into bread. This is due to the character of one of its proteins, namely, gluten, which, when coagulated, is sufficiently strong and elastic to form bubbles from the effect of the expansion of the gases resulting from the action of yeast or other leavening agents, thus producing a light porous loaf. There are various sorts of wheat flour, which include different proportions of the wheat kernel. Graham flour is practically unbolted wheatmeal, containing the whole of the grain. Entire wheat flour is somewhat similar, but the bran has been sifted out and the rest of the grain is more finely ground than in Graham flour. In milling white or patent flour both the bran and the germ are removed. The latter is taken out because flour in which it is retained

to become rancid; unfortunately, removing the germ also deprives the flour of vitamines which are present in the germ in considerable quantities.

Macaroni and spaghetti, sometimes called wheat pastes, are made from a special type of grain called durum wheat, that is particularly rich in gluten of a somewhat different character from that in the wheat used for bread flour.

Rye flour resembles wheat flour to some extent in composition and in bread-making properties, but the loaf is not as light and porous as that made of wheat. A lighter loaf is made by mixing wheat flour with the rye.

Corn is used chiefly as cornmeal and corn flour. In the old process of making cornmeal the whole of the grain is ground and the coarser particles are sifted out, but some of the bran and all of the germ are retained with the starchy part of the grain. Such meal is relatively rich in protein and fat, but because of the latter it tends to become rancid. It is commonly preferred for both its flavor and its culinary properties to cornmeal or flour made by the new process in which most of the bran and the germ are removed. Yellow and white meals are ground from grains of corresponding color and do not differ in nutritive value.

Old-fashioned hominy as used by the pioneers was made by pounding dried corn and removing the hulls. The coarse hominy, samp or pearl hominy that is much used at the present time in the Central and Eastern States is somewhat like it, the grain being split to remove the germ, and hulled. Fine

iny, or hominy grits, is made by grinding the se hominy. These products can be served as egetable substitute, as rice is sometimes used. s are also used as breakfast food. Lye hominy, ulled corn, is prepared by boiling corn with lye emove the hull and germ and then washing it oughly. This product is greatly relished in e regions either as breakfast cereal or in place ne of the vegetables in a meal.

orn starch is practically clear starch made from by special preparation which removes the other tituents of the grain. The nutritive material apioca and sago is also chiefly starch, but these not cereal products.

olled oats are commonly called oatmeal, but are not ordinarily ground into meal in this itry. The steamed grain is passed between rs and flattened into flakes. The oats are partly ed in the process, but require further cooking nake them palatable and digestible. The pro-ion of both protein and fat is larger in oats in any of the other cereals and that of starch tly smaller.

ice contains a larger proportion of starch and a ler proportion of protein than the other cereals. of the lack of protein is due to the removal he bran in polishing. The most serious loss ting from this process is that of mineral matter vitamines. The deficiency in these substances, cially the latter, causes serious physiological rbances in people living largely on white or ed rice. Whenever rice makes up th

of the diet it is wise to use the unpolished sort, but when it is combined with other foods in a mixed diet any sort that is preferred may be eaten. Rice is used in a variety of ways, as breakfast cereal, as a vegetable, as part of the flour in bread making, for thickening soups and meat dishes and for making desserts.

Barley has been used most commonly as pearled barley for thickening soup, but it can be used in a variety of ways, such as breakfast cereal, as a vegetable dish with meat, or even for making puddings. More recently barley meal and flour have been used with other flour in making bread.

The woody fiber known as cellulose, which is present to some extent in all the cereals, particularly in the bran, has little actual nutritive value because it is not digested. Its chief value is in giving bulk to the intestinal contents. It is quite possible that the rate of digestion and absorption of starch may be retarded by cellulose, so that starchy foods containing fiber supply the body with fuel material more gradually than clear starch or sugar. This may be an advantage, when muscular work is carried on, by keeping the body supplied with the energy required for the work without depleting the store of glycogen.

None of the cereals, nor of the products made from them, is of itself sufficient for normal nutrition; neither are combinations of different cereals; but the addition of a small amount of food material of some other class, such as milk or cheese, or even vegetable foods, m[illegible] a combination which is ad

quate. It is quite appropriate, therefore, that cereal foods of different sorts shall contribute the larger part of the nutritive material in a well-chosen diet, particularly where economy is considered, because the greater the proportion of cereal used the more economical the diet. It is necessary to remember, however, that the nutritive material in cereals, when utilized by the body, leaves residues which tend to reduce the alkalinity of the tissues and fluids. For this reason cereal foods should be balanced by fruits and vegetables, the residue from most of which is alkaline.

In the diet suggested above for the average man in good health doing a considerable amount of work each day, the quantity of cereal proposed would include about 9 ounces of flour, or its equivalent of 11 to 12 ounces of bread, and 3 ounces of other cereal, including flour for cooking and various sorts of cereal products, such as oatmeal, cornmeal, rice and barley. Among the prepared cereal products are many sold in packages at prices which make the cost of nutritive material per pound enormously high in comparison with that of an equal amount of the same product purchased in bulk or of the same cereal in some other form. Oatmeal and cornmeal mush are more valuable foods than special breakfast cereals and much more economical. While there is no objection to the use of the expensive proprietary package foods, except on the score of economy, it should be remembered that they are purchased simply because of preference for their flavor or for ease of preparation and not b they possess any special food value.

VEGETABLES AND FRUITS.—Though vegetables and fruits comprise a large part of the total material in any normal diet, they furnish only a small part —less than 10 per cent.—of the total energy supplied, and as sources of protein they are much less significant except in the case of legumes, which, however, are included in another group of foods. If fruits and vegetables were not included in the diet there would be no shortage of protein, fat or carbohydrate; on the other hand, these products contain in such abundance the mineral substances so essential to the body in building and repairing tissue and maintaining normal alkalinity that no other food substance can replace them advantageously, and they also supply the vitamines that are required for growth and for maintaining health. They provide bulk and furnish organic acids and flavors that add a pleasing variety and palatability that is conducive to good digestion. A well-planned diet would make ample provision for this class of food material.

The total amount of such materials in the suggested diet would include not less than 14 ounces of fresh potatoes or sweet potatoes. The common white potato is one of the valuable articles of food whose popularity is due, no doubt, in large part to plentifulness and low price and the variety of ways in which it can be prepared, but also to the fact that to a large extent potatoes satisfy the physiological needs of the body. The larger part of the energy-yielding material furnished by the foods of this group is in the potatoes eaten; they supply an appreciable amount of starch and a small amount

of protein; they are rich in mineral matters and they contain vitamines. Potatoes leave probably a greater proportion of alkaline residue than any other food, and for this reason are especially valuable in combination with protein-rich food, which leaves an acid residue. Well-cooked potatoes are easily and quite thoroughly digested. Much of the nutritive material is lost in some methods of preparation, particularly the protein and mineral matters, which are most abundant in the layers beneath the skin. In careless paring as much as a fifth of the mineral substances and protein may be lost, and more is lost in the water in which peeled potatoes are soaked and boiled. The loss is very much less when the potatoes are cooked "in their jackets," and that in baking and steaming potatoes is also small.

The sweet potato is somewhat similar to the white potato in composition, although in addition to an equal amount of starch it has also some sugar. Some of the starch of the sweet potato changes to sugar during storage at ordinary temperature. Sweet potatoes are not as easily kept as white potatoes, and often their cost is greater; but for the sake of variety, at least, they should occasionally be substituted.

Whenever practicable the diet should include at least 4 ounces of vegetables other than potatoes, and a larger quantity would be still better. These are not economical as sources of nutrients, the fresh green seeds like beans, peas and corn being richest in this respect, the roots such as beets, carrots and

parsnips next, and the stalks and leaves such as celery and cabbage least of all; but for variety, flavor and palatability they are all valuable, and especially so for the mineral substances and vitamines they furnish. Unless these materials are included there is danger that the diet will be lacking in some of the essential inorganic constituents, especially calcium, phosphorus and iron. They also provide "roughage," or bulk, that is essential in every normal diet. Such vegetables as cabbage, spinach, turnips, cauliflower and celery are of this character.

A certain amount of fruit is also to be recommended for much the same reasons. Fruit for breakfast is especially relished. The suggested diet would include regularly at least 2 ounces of such dried fruit as prunes, peaches and apples, or an equivalent amount, about 8 to 12 ounces, of fresh fruit at frequent intervals. The tendency of many diets, particularly that of the army, is toward one resulting in acid residues. One of the benefits of fruit is that although many of them are sharply acid in flavor the residues from most of them are alkaline and assist in preserving the normal alkalinity of the blood and tissues. Most fruit acids are oxidized in the body. Fruits are more or less laxative in effect and their sweet and acid flavors are much relished. Their antiscorbutic properties are very important.

Fats.—The fats of food, including vegetable oils *as well as animal* fats, are concentrated energy foods, *their fuel value being* more than twice that of carbo-

hydrates or protein. All of the fats that are liquid or will melt at the temperature of the body are quite thoroughly digested and serve the body equally well as sources of energy. Some of the harder fats, which melt at higher temperatures, are less readily and less completely digested. All fats are more slowly digested than the other food constituents, and by forming a coating over other food particles tend to retard their digestion also. Because hearty foods rich in fats act in this way they delay the occurrence of the sensations of hunger, which begin after the stomach has become empty, and for this reason they are said to have more "staying power," while foods lacking in fat have less.

The quantity of fat to be included in the diet as suggested on page 113 is exclusive of that eaten with the lean of the meat. It represents fat used in cooking and in other ways to make the diet richer and more palatable. About one-third of the quantity would be bacon or salt pork for use by itself, or with beans and other vegetables; the rest would include butter and oleomargarine for use on bread, vegetable oils for salad dressings and lard or lard substitutes for shortening and frying. It is often not necessary to buy fats for this latter purpose, however, because drippings and fat tried out of that trimmed from meat can be used.

Cottonseed, corn and peanut oils are satisfactory substitutes for olive oil for many uses. Hardened cocoanut oil with some milk added to give flavor is a wholesome butter substitute, and other butter substitutes made from animal and vegetable oil

valuable, though none of them should replace but entirely because they do not contain the fat solul substances necessary for growth and health. Th deficiency in such substances is least signific when the diet includes an abundance of fresh fru and green vegetables. It is well to include so butter in the diet even when the price is quite hi or to insist that the substitute shall include at le 10 per cent. of butter fat.

SWEETS.—This group of food materials inclu the ordinary beet and cane sugar, maple sug molasses, glucose, corn and sorghum syrups, hon and the foods in which they are used, as sw chocolate and other candies, fruits preserved sugar, jellies, jam, sweet cakes and desserts, togetl with dried fruits such as raisins, dates and f which contain appreciable quantities of sugar.

Sugar is not an indispensable article of diet, l the flavor which it imparts to food is very grea relished. It is a fuel food, and at ordinary pri is one of the most economical sources of ener When not used in excess it is very easily and co pletely digested, and its energy is more quic available to the body than that from any ot source. Furthermore, it is possible to do a grea amount of work without fatigue when sugar l been eaten than without it. Whenever there is ne for sudden expenditure of energy the diet m include considerable amounts of sugar, but it is w to eat it at frequent intervals rather than in lar quantities. In excessive amounts sugar may ca igestive disturbances, or may even result ter

rarily in the presence of sugar in the urine. Furthermore, it may destroy the appetite for other foods and thus decrease the amount of vegetables and fruits eaten, so that the body would fail to obtain the amounts of calcium, phosphorus and iron necessary to maintain health. For this reason sweets should be eaten at the end of a meal.

The amount of sugar in the suggested diet would include that used in sweetening tea or coffee or cereal, the sugar, molasses or syrup used for flavor in cooking and that in the dried or preserved fruits, jams or jellies. Sugar comprises from one-third to two-thirds of the total substances in well-made food materials of this class.

SEASONING.—A considerable number of materials such as salt, pepper, vinegar, spices, herbs, pickles, horseradish, flavoring extracts and others, commonly called condiments, are used in the preparation of palatable meals. Condiments furnish little or no nourishment themselves, yet add materially to the value of the diet because of the relish they impart to foods otherwise bland or insipid. The secret of making palatable and even attractive meals from inexpensive food materials lies to a great extent in the skilful use of condiments. The increase in palatability adds to the pleasure of eating and consequently aids in digestion, as explained in the chapter on Digestion and induces the feeling of satiety. On the other hand, food too highly seasoned is not to be recommended, and condiments should never be used to make palatable any food that is spoiled or otherwise unwholesome.

PLANNING MENUS FOR A BALANCED DIET.

The planning of menus for messes in the army should receive careful consideration, both because the satisfaction of the men with their food contributes very materially to their contentment and efficiency, and in order to prevent the enormous losses that result from lack of attention to such details. The ration allowance of the soldier if expended with judgment will provide abundantly for all the necessities, and even to some extent for indulgences, but it does not allow for waste or mismanagement. Since radical changes in the diet are sometimes disturbing, it is well to ascertain the food habits and customs previously acquired by the men in a mess, and so far as possible to plan meals in accordance with them, provided they are not essentially improper. On the other hand, the men should be encouraged to acquire a liking for wholesome and nutritious food that may be strange to them but more readily obtained than that which they may happen to know and prefer. Palatability and attractiveness often depend quite as largely upon the skill with which the meals are prepared and served as upon the materials supplied.

The important objects to be considered in planning menus are to make the most economical use of all available food materials, while gratifying, so far as possible, the tastes of those fed and supplying the essential nutritive constituents in the right proportions. This is what is meant by a balanced diet. Attention to the use of proper proportions of the five classes of food materials enumerated on page

113 is essential in this connection to avoid one-sided meals. For example, a dinner which includes purée of dried peas, roast beef, Yorkshire pudding, cheese-potatoes and custard for dessert would be over-rich in protein, or what is popularly termed heavy, because too many of the items of the first group mentioned are used. A meal including cream of tomato soup, mutton chop with creamed potatoes, bread and butter, and suet pudding with butter sauce, would be decidedly rich in fat; while a meal including macaroni and cheese, baked potatoes, stewed tomatoes, bread and butter and chocolate blanc mange would supply an unusual proportion of carbohydrate. There is no serious objection to an occasional meal such as either of these if it is attractive and palatable. Nothing in particular is to be gained by striving for strict balance in every meal or even in the total food eaten each day. The fault to avoid is persistent indulgence in meals that include an excess of foods from any one of the groups mentioned to such an extent that the diet as a whole may be characterized as unbalanced. Menus planned in accordance with a scheme of meals like that given below, in which the quantities of foods are indicated according to their fuel values, would be sufficiently well balanced to meet the demands of unusually active, healthy men, like soldiers undergoing intensive training.

A wide variety of menus that would meet all bodily requirements for tissue constituents, regulating substances and energy can be provided in accordance with such a scheme. It is not es

that any given meal shall agree exactly with the one corresponding to it in the outline suggested: if the values for the meals for several days are on the average in approximate agreement with those suggested the diet will be sufficiently well-balanced for all practical purposes.

	Breakfast, calories.	Dinner, calories.	Supper, calories.
Fruit	150		
Cereals other than bread	250		
Soup	..	..	100
Meat or substitutes	350	300	350
Potatoes	..	200	150
Other vegetables	..	50	100
Bread	300	250	300
Butter	100	150	100
Milk	100		
Sugar	150		
Dessert	..	250	300
	1400	1200	1400

A very satisfactory breakfast may consist chiefly of fruit, cereal and milk, bread or toast with butter, or hot cakes with syrup, and coffee with milk and sugar. Bacon and eggs when plentiful, and less frequently steaks, chops or stews may be added, according to the menu for the rest of the day; but commonly heavy meat dishes are unnecessary at this meal. Potatoes are often relished for breakfast.

The midday meal should be substantial, but should not be heavy, because it is usually followed by a period of exercise, and it is not good practice to perform hard work after a hearty meal. This is in accordance with the custom of workingmen in this country, the large proportion of whom eat a

light dinner or lunch at noon. A dish of macaroni and cheese, or rice and cheese, or a meat stew with vegetables or salad, bread and butter, and a dessert of pudding or pie constitute a nourishing and palatable lunch. The meal should not be too light and too readily digestible, because when foods leave the stomach quickly the men become hungry before the next meal time. This condition often results in the purchase of something to eat, with loss of appetite for the regular meal and consequent waste of food. Fat in the food tends to retard its passage from the stomach and to delay the onset of hunger.

A well-planned supper may include soup, a meat dish, potatoes and at least one other vegetable, meat gravy, bread with butter or jam and a dessert. Such a meal is preferable at the end of the day when there is more time to enjoy it and no heavy work to follow it. Moreover, it is followed by a long period until the next meal, hence it should be hearty in character and should digest slowly. It is believed that the practice of feeding the hearty meal at night would reduce the amount of food eaten outside the mess. If it is preferred to give the heavy meal at noon, supper should be at least as substantial as the suggested dinner, and should always include at least one hot dish.

Three meals in substantial agreement with the suggestions given above could be prepared from the menus which follow. These are given rather as an illustration of the methods of calculation than because of any special merit in the meals. The quantities are given in pounds and the v sufficient for 120 men:

BREAKFAST.

Cornflakes	10 pounds
Milk, evaporated	9 "
Sugar	4 "
Fried bacon	20 "
Fried potatoes	35 "
Bread	25 "
Prunes	10 "
Sugar	4 "
Coffee	6 "
Milk	4 "
Sugar	4 "

DINNER.

Macaroni	15 "
Cheese	5 "
Milk	5 "
Sliced bologna	20 "
Cold slaw:	
Cabbage	40 "
Milk	2 "
Butter	1 "
Sugar	½ "
Vinegar and spices	
Bread	30 "
Jam	12 "
Cocoa	5 "
Milk	6 "
Sugar	6 "

SUPPER.

Corn chowder:	
Canned corn	6 "
Milk	4 "
Bacon	2 "
Onions	3 "
Potatoes	10 "
Soup stock	10 gallons
Beefsteak	40 pounds
Gravy:	
Flour	"
Mashed potatoes	35 "
Milk	3 "
Green peas	20 "
Bread	30 "
Preserves	15 "
Rice pudding:	
Rice	8 "
Sugar	6 "
Milk	4 "
Raisins	4 "

Breakfast.	Per 120 men, lbs.	Per man, gms.	Protein, %	Fat, %	Carbohydrate, %	Protein, gms.	Fat, gms.	Carbohydrate, gms.
,kes	10	38	11.0	1.0	77.0	4.2	0.4	29.3
. . . . . .	20	76	6.2	67.9	....	4.7	51.6	
es	35	132	1.8	0.1	14.7	2.4	0.1	19.4
. . . .	25	94	10.0	1.0	58.0	9.4	0.9	54.5
, evaporated .	10	38	1.8	....	62.2	0.7	....	23.6
. . . . . .	12	45	....	....	100.0	....	....	45.0
vaporated . .	13	49	7.1	7.8	9.6	3.5	3.8	4.7
Total for one meal: grams						24.9	56.8	176.5
calories . . .						102	528	723
Total calories, 1353								
Dinner:								
›ni	15	57	13.4	0.9	74.1	7.6	0.5	42.2
. . . . . .	5	19	25.9	33.7	2.4	4.9	6.4	0.5
a	20	76	18.9	19.2	....	14.4	14.6	
ge	40	151	1.4	0.2	4.8	2.1	0.3	7.2
. . . . . .	1	4	1.0	82.0	....	....	3.3	
. . . . . .	30	113	10.0	1.0	58.0	11.3	1.1	65.5
. . . . . .	12	45	1.0	....	60.0	0.5	....	27.0
. . . . . .	5	19	21.6	28.9	37.7	4.1	5.5	7.2
:vaporated . .	13	49	7.1	7.8	9.6	3.5	3.8	4.7
. . . . . .	6.5	25	....	....	100.0	....	....	25.0
Total for one meal: grams						48.4	35.5	179.3
calories . . .						198	330	735
Total calories, 1263								
Supper:								
:anned . . .	6	23	2.8	1.2	19.0	0.6	0.3	4.4
:vaporated . .	11	42	7.1	7.8	9.6	3.0	3.3	4.0
. . . . . .	2	8	6.2	67.9	....	0.5	5.4	
i	3	11	1.4	0.3	8.9	0.2	....	1.0
es	45	170	1.8	0.1	14.7	3.1	0.2	25.0
. . . . . .	40	151	15.7	17.0	....	23.7	25.7	
. . . . . .	3	11	11.4	1.0	75.1	1.3	0.1	8.3
:anned . . .	20	76	3.6	0.2	9.8	2.7	0.2	7.4
. . . . . .	30	113	10.0	1.0	58.0	11.3	1.1	65.5
ves	15	57	1.0	....	60.0	0.6	....	34.2
. . . . . .	8	30	8.0	0.3	79.0	2.4	0.1	23.7
. . . . . .	6	23	....	....	100.0	....	....	23.0
s	4	15	2.3	3.0	68.5	0.3	0.5	10.3
Total for one meal: grams						49.7	36.9	206.8
calories . . .						204	343	848
Total calories, 1395								

Total for one day: grams 123 125
calories 504 125
Total calories, 4011

The table on page 133 shows the food values of the meals outlined on page 132. The method of deriving the figures given in the table may be illustrated by the following calculation of the values for bread.

Thirty pounds of bread for 120 men is equal to 113 grams per man.

$$\frac{30 \times 454}{120} = 113 \text{ (one pound equals 454 grams)}$$

The composition of bread is shown in the table in Chapter I, namely, protein 10 per cent, fat 1 per cent., and carbohydrate 58 per cent. The 113 grams of bread per man would therefore supply:

$113 \times 0.1 = 11.3$ grams of protein.
$113 \times 0.01 = 1.1$ grams of fat.
$113 \times 0.58 = 65.5$ grams of carbohydrate.

In the same manner the values for each of the foods in the three meals are computed.

From the total grams of protein, fat and carbohydrate supplied at breakfast the energy per man is derived in this manner: (grams of protein x 4.1) +(grams of fat x 9.3)+(grams of carbohydrate x 4.1) is equal to the fuel value. Thus:

$24.9 \times 4.1 = 102$ calories (1 gm. protein yields 4.1 calories)
$56.8 \times 9.3 = 528$ calories (1 gm. fat yields 9.3 calories)
$176.5 \times 4.1 = 723$ calories (1 gm. carbohydrate yields 4.1 calories)

Total 1353 calories

In the same way the fuel values for the other are calculated. To get the fuel value of the

food supplied for the day it is necessary only to add the totals for each of the three meals. The proportion of the total energy derived from each of the nutrients is:

$$\frac{504 \times 100}{4011} = 12.6 \text{ per cent.}$$

$$\frac{1200 \times 100}{4011} = 29.9 \text{ per cent.}$$

$$\frac{2307 \times 100}{4011} = 57.5 \text{ per cent.}$$

Menus for a period of ten days or two weeks should be planned to keep the diet in balance and to avoid any monotonous repetition of foods. Even when a small number of staple foods, as meat, potatoes and a few other vegetables, dried fruit and flour and a few other cereals, comprise the large part of the materials available, considerable variety in the meals is still possible. This depends as largely upon different methods of preparation as upon range in the choice of material, and is more the result of change from meal to meal and from day to day than of including a large number of items in a single meal. Numerous palatable and attractive meals can be made which include only one dish. To serve a "surprise" at one meal each day will aid materially in keeping the men contented with their diet. If conditions are such that similar meals must recur at frequent intervals they are less apt to become monotonous if they repeat not *oftener than* every ten days than if they occur on *the same day* each week.

Monotony in condiments and flavors is to be avoided; for example, onions should not be used to season two dishes in the same meal. Care should be taken also not to include two liquid dishes such as beef stew and stewed tomatoes, to be served together in the same mess kit.

Meat dishes can be varied more easily than perhaps any other part of the ration, owing to the number of different kinds of meat food and methods of preparation; moreover, there are several satisfactory substitutes from which attractive dishes can be prepared, many sorts of beans as well as cheese and eggs being used in this way. Nutritious and palatable meat substitute dishes can be made also from peanuts, which are richer than beef in both protein and fat, and at ordinary prices are more economical. In hot weather the quantity of animal food may be reduced, and compensated with more fresh vegetables, relishes and fruits.

The potato is a valuable constituent of the diet that is commonly included in two meals each day, and to some extent even in three. Variety should be sought in the method of preparation of potatoes.

A meat dish that is generally much relished is well-made hash, which provides a valuable method of using left-over meat and potatoes, though precautions are necessary in making it. The ingredients should be wholesome and absolutely above suspicion of taint or contamination, and they should not be prepared long before they are to be used, because the finely divided substance offers large urface to the invasion of bacteria, and may hav

been contaminated in the chopping or grinding. If meat and vegetables mixed together are allowed to stand over night at ordinary temperatures, decomposition is likely to occur. When hash is to be served for breakfast, if the ingredients must be prepared the previous evening they should be kept separate until morning and kept cold if possible.

Soup is recommended for one meal each day, and could be included oftener. It could be served in mess cups in place of a beverage. Good soup not only gives pleasure and satisfaction, but also provides a method of using left-over meat and bones and trimmings from fresh cuts of meat. When soup is thickened with cereals or with vegetables, it adds considerable nourishment to the meal. Many soldiers do not like soup because that with which they are familiar is not palatable. Effort should therefore be made to provide soup of good quality.

Flour is the cheapest component of the ration, and bread is included in practically every meal; hence attention to different methods of bread making is worthy of consideration. Good bread is always relished, and a variety of raised breads and buns is appreciated and their use would probably reduce the quantity of more expensive food used.

Something should be provided to eat on bread at each meal; besides butter and butter substitutes, jam, jelly and syrups are greatly relished.

The utmost use should be made of the fruit component of the ration—fresh fruits as often as possible when they are available, and all the com-

mon sorts of dried fruits at other times. Fresh fruits that are to be eaten raw, such as apples, pears, peaches and grapes, should be washed before they are served; and dried fruits should also be inspected and freed of unsound or unwholesome material of every sort, and the part to be used should be very thoroughly washed before it is cooked. These may be served for breakfast as stewed fruit or incorporated with cereal; for example, cooked prunes with the stones removed or dates ground in a meat chopper may be stirred into oatmeal just before it is ready to serve. For other meals they may be made into dumplings and fritters, and for dessert they may be made into cobblers, puddings and pies. Sweet desserts should be served as frequently as possible. The craving for sweets is natural, and within normal limits it should be satisfied in the mess. The men should not be driven to the exchange or elsewhere for food which should be supplied to them.

Coffee and tea are stimulants, and the use of large quantities of them should not be encouraged. They have virtually no nutritive value other than that of the milk and sugar used with them. Cocoa and chocolate used as drinks have some food value, but they are equally as stimulating as tea or coffee, and no more to be recommended than they are. If there is plenty of water to drink less of the other beverages will be used; for this reason, and also because water with meals is beneficial, there should always be an abundant supply at each meal.

CHAPTER VI.

KITCHEN ECONOMY AND MESS MANAGEMENT.

THE mess officer to be successful must thoroughly understand the duties of the enlisted men connected with his mess. This knowledge is best obtained by experience, but it is necessary to be familiar with the paragraphs of *Army Regulations* and also with the contents of the *Manual for the Quartermaster Corps*, bearing upon food and messing, and the *Manual for Army Cooks* (1916). The mess officer will be called upon for all sorts of advice, and he should qualify himself on the scientific side of nutrition by the study of standard books on this subject. Books to be recommended are:

Feeding the Family, by Mary S. Rose.
Food Products, by Henry C. Sherman.
Fundamental Basis of Nutrition, by Graham Lusk.
Food for the Worker, by Stearn and Spitz.

ORGANIZATION.

Three essentials of a successful mess are good food, cooking and organization. The mess sergeant, under the mess officer, is in direct charge of the details relating to the mess; his duties include the ordering of goods from the commissary and from

outside merchants. He must be absolutely honest, must keep the mess accounts up to date and see that cooks, assistant cooks and kitchen police perform their duties. Each enlisted man connected with the kitchen should know what is required of him and he should be taught to work in a systematic manner. The chief cook, under direction of the mess sergeant, should have full charge of the kitchen and the preparation of the food during his hour of duty. He is to have control of the assistant cooks and kitchen police who are to help him in the preparation of the mess. Dining-room orderlies and men who have general police duty are usually under the direct charge of the mess sergeant.

FOOD.

INSPECTION.—The mess sergeant is responsible for the quality of food served in his mess, and is required to inspect all food as soon as it is delivered. He must know, for example, whether fresh beef is of the quality demanded by Army specifications, which he should learn from the *Manual for Army Cooks*. It is necessary, of course, for the mess officer also to know these specifications and be able to train the mess sergeant in judging not only beef but all other foodstuffs, as explained in Chapter II, and in the disposition of material rejected. All spoiled goods must be sorted out and disposed of. Unless the amount of spoilage in goods delivered is *negligible*, claim for credit should be immediately *put in for loss of* spoiled foodstuffs.

Milk and ice-cream purchased for use in the sol-

dier's mess should be passed upon by the proper sanitary officers.

COOKING.—The mess officer should pay careful attention to the preparation of food; he should see that the foods prepared are palatable and, so far as possible, suitable to the tastes of the men—not cooked in a manner that impairs the quality or appearance, and they must not be over- nor under-seasoned. Careless cooks who allow food to become scorched or fail to provide meals to meet with the general approval of the organization are to be cautioned and closely watched for a time and then summarily dealt with if no improvement is perceptible. Careless preparation means wastage of food and a discontented organization whose morale is apt to be low. Cooks should be urged to try steadily for improvement, and when they know their trade experimentation will add variety. Cooks under the mess sergeant's direction should follow closely the *Manual for Army Cooks.* The mess officer should inspect each meal and taste the food before it is served.

SERVICE.—The cooked food should be properly served. Food that is generally eaten hot should be served hot. It should not be allowed to stand until cold before mess call. This requires systematic management on the part of the mess sergeant and quick service by the dining-room orderlies. If the mess officer does not make frequent visits to his mess the kitchen force may become lax in the matter of serving, and the garbage can will overflow with food discarded because it is unnecessarily distasteful

There are two systems of service in vogue in army camps: one is known as the line or cafeteria style and the other the squad or table service system. The simplest for the cooks and kitchen police is the line system, since mess kits are used and the men wash their own kits. This system is often less satisfactory than the squad system and usually much more wasteful of food. In the line system the men get any sized portions of food that the cook or kitchen police may happen to deposit on the mess kits; they often get more than they want and frequently the kind of food they do not like. The result is a great wastage or consumption of distasteful food.

The squad or table system has none of the disadvantages mentioned above and is more pleasing to the men, but is likely to prove more expensive in time of personnel and equipment. Food is placed on the tables just before mess call; the men file in, stand at attention until all are present and take seats upon order to do so. Each squad or each ten men at a table are in charge of a non-commissioned officer who is responsible for the conduct of the men at his table. He sees that every man gets a fair helping and reproves those who are inconsiderate. If any men prove to be gourmands and take upon their plates more than they can eat they should be moved to a special table. Another corrective measure is to save what a man leaves and make him eat it at the next meal. Men who persist in wastefulness should be severely disciplined. In some organizations the squad system is slightly modified

in that a man from each table or squad is detailed to go to the service table and carry the hot food to the tables after the men have come into the mess hall.

The men should be required to show empty plates to the non-commissioned officer in charge of the table before they leave. Any food that is left over on the service platters or in the kitchen can be saved for use at a following meal. Any food left on the men's kits or plates should, on sanitary grounds, be rejected. The greater economy of the squad as compared with the line system has been demonstrated, at least for the training camps. It will entail an expenditure from the company funds for serving dishes and plates, but it is well worth while for the comfort derived and the economy effected. This system of messing is to be recommended whenever the conditions permit its use. It may not, of course, be practicable in the field.

Cold water should be placed on the tables in pitchers at each meal. This will enable the men to satisfy their thirst and cut down the volume of coffee consumed. A glass of cold water stimulates the flow of gastric juice and thus is an aid to digestion. Good soup may often be used as a drink at one meal of the day. Soup made from good stock is nourishing and has the flavor of meat extract, which when taken at the beginning of a meal stimulates the appetite.

Due to the tendency to large consumption of *coffee, quality* will suffer for the sake of quantity. *Complaints* against the coffee served in mess

quite common and often justified. Mess officers should insist that good coffee be served. A moderate amount of coffee of pleasant aroma and taste is better than large volumes of the weak, overboiled, brown-colored decoction that is so commonly served. A pleasing beverage is dependent upon (1) the use of a good grade of coffee, and (2) steeping for a short time in boiling water. Prolonged boiling volatilizes the aromatic oils and extracts the tannins, ruining the flavor. Too often the mess sergeant makes a saving by his parsimony with coffee, resulting usually in a weak and very poor tasting beverage. When coffee is used it should be made as good as possible with the grade of coffee at hand. Excessive use of coffee should be avoided, due to the stimulating effect of the drug caffein and to the constipating effect of the tannin which coffee contains. The stimulating effect is also objectionable in the beverages sold at soda water fountains, and such drinks should be avoided.

BREAD.—Serve in thin slices of small area and cut so that no "heels" are left except from the two outside loaves. This can be accomplished best according to the accompanying figure.

FOOD WASTE.—Waste of edible food is not to be tolerated, and with such organization as is found in the Army, waste is entirely unnecessary and preventable. It can result from several causes: (1) Food may be allowed to spoil by careless storage; (2) it may be carelessly prepared; (3) too much may be cooked; (4) it may be poorly cooked; (5) the men may take more on their plates

than they can eat. The first three causes are to be controlled by the mess sergeant, who is responsible; the fourth by the cook; the last by discipline. Left-overs on the platters are to be returned to the kitchen and used at a subsequent meal as such or worked up into palatable dishes. Left-over foods

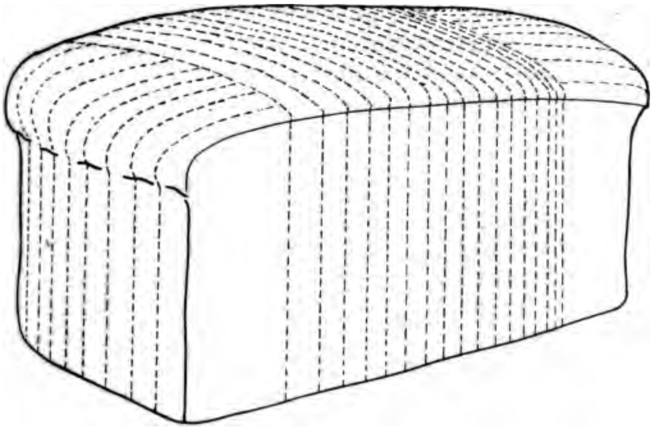

FIG. 4.—Diagram showing method of cutting bread which reduces the amount of heel.

should be utilized as quickly as possible; they are not to be kept more than twenty-four hours and are to be stored in the refrigerator or where there will be no danger of spoilage. Left-overs are to be examined before use to determine whether they are *soured or spoiled*. Some of the uses for left-overs are:

Bread.—Croutons for soup, bread pudding, plum-duff, toasted and ground as filler for meat pies, Hamburg steak, breaded meats and fish, scalloped potatoes, stewed tomatoes, batter cakes, corn cakes, muffins and French toast.

Beans and Peas.—Soup, stew and salads.

Beets.—Salad.

Bones.—Soup and gravy stock.

Corn.—Soup, stews and fritters.

Cornmeal Mush.—Fried corn mush.

Meats.—Hash, croquettes, pies, curries, stews, stuffed peppers.

Oatmeal.—Pudding, batter cakes and muffins.

Potatoes.—Hash, croquettes, salads, potato cakes, stews, meat pies.

Rendered Fat Residue, or "Cracklings."—Hamburg steak, cornbread.

Rice.—Pudding, soup, batter cakes and muffins.

Left-over hash should not be saved. Great caution should be exercised before adding left-overs to fresh food. For example, in one case a mess sergeant added some left-over cooked farina to a new batch, which resulted in rendering the whole unfit to be eaten. He had not observed that the left-over farina was slightly sour.

The soup-stock pot, if properly managed, serves as a great economizer of food. Green bones, after the meat has been trimmed off, are to be cracked and put in the stock pot and boiled. The stock pot must be very carefully watched, however, on account of the danger of its becoming sour. Addi- of good vegetables to tainted stock would

naturally result in the loss of the former. A good rule to follow in order to ensure safety is to keep the stock in the pot simmering, especially in the evening, and keep the cover in place. Bone extractives form an excellent culture medium for bacteria, which are ever present in the air and dust and which drop into an open container. Bacteria and their spores thrive and develop very rapidly at about the temperature of the body. Boiling water kills them, hence the stock pot should be kept hot. The practice of adding fresh bones to the pot without removal of the stale contents is dangerous. The soup stock not used should be thrown out once every day and the pot thoroughly cleansed. Meat and fat left on the cooked bones should not be thrown away. This residue is of very high food value even though the boiling process has extracted the flavor from it; it can be used in hash.

The practice of adding milk and sugar to the coffee before serving is bad, since it not only prevents the indulgence of individual preference as to the use of these ingredients, but in case too much coffee be prepared the milk and sugar contained therein are often wasted. The extent of waste from this practice had not been appreciated until the study in one of the cantonments showed that 30,000 pounds of sugar and 14,000 pints of milk were being wasted in this cantonment per month, due to mixing the sugar and milk with the coffee before serving. Where men are allowed to make their own additions of milk and sugar these difficulties may be obviated. The men should be required to stir

coffee after they have added sugar until the latter is dissolved; then if, on inspection, undissolved sugar is found at the bottom of the cups, the men should be disciplined. It must be remembered that it is less trouble to add twice as much sugar as is necessary to produce the desired degree of sweetness, and then trust to half of it dissolving spontaneously, rather than to see that all sugar added is actually dissolved. Where the squad system is properly operated there is no trouble in controlling the men in their use of milk and sugar. Frequently the cups or containers for coffee are entirely too large for one person, which results in wastefulness because some soldiers will fill the cups no matter what the size; it rarely occurs to them to half fill a large cup and drink all rather than fill it and drink only half.

There is no excuse for the waste of bread. It is clearly the mess sergeant's, and finally the mess officer's fault if bread is found in the garbage can. Bread waste is due to one of the following causes: (1) the slices are too thick, (2) they are too large, (3) absence of water or other beverage, (4) overdrawing of bread by the mess sergeant, (5) thoughtlessness or carelessness on the part of the men. All of these causes are controllable.

The fat trimmed from meat should never be thrown away or used for fuel. It is to be chopped up and rendered. The clear renderings can be substituted for lard in the preparation of food. Grease unfit for food is suitable for soap making and commands a good price. Such fat should be saved

placed in a proper container, and when sufficient is accumulated can be sold. This is usually done by the Reclamation Service of the Quartermaster's Department.

Economy in peeling and paring is exceedingly important. Potatoes should always be peeled with a potato parer or scraper, never with a knife. It is most economical, however, to cook the potatoes with the skins on because in this way the loss of the starchy and protein matter and mineral salts is reduced to the minimum. Furthermore, the skin can be removed from boiled potatoes with very little waste when the potatoes are not overcooked. On this account there are Division Orders in some cantonments forbidding the paring of potatoes until cooked. Even when it is desired to serve mashed potatoes they can be boiled with the skins on, then peeled and mashed. New potatoes should be scraped and not pared. The skins of (well-washed) baked and boiled potatoes are wholesome and very palatable when one has cultivated a taste for them, which should be encouraged. Carrots should be scraped, not pared; and beets should be peeled only after having been boiled, when the skins may be drawn off easily as soon as the beets are cool enough to handle.

Wastefulness in a mess can be readily checked by frequent inspection of its garbage cans. The edible and inedible waste from each organization should be separately weighed at frequent intervals. Definite figures are thus obtained, comparisons between messes can be drawn and rivalry

among mess sergeants established which will cause them to strive to keep down the waste. The mess sergeant should be held responsible for wastefulness and he should be promptly disciplined if unreasonable amounts of food are found in the garbage. (See the 83d Article of War.) The mess sergeant in turn holds the squad corporals responsible for table waste. Well-managed and economical messes can maintain an average much below 0.2 pounds per man per day of plate scrapings and 0.5 pounds per man per day of total garbage (exclusive of refuse such as cans, bottles, papers, etc.). *Cash savings should be earned by preventing loss through the garbage, not by parsimony in feeding the men.* The loss through garbage becomes negligible if the mess officer intelligently and efficiently supervises his messes, if the mess sergeant is careful and maintains proper discipline and if the cooks are masters of their art.

Recovery of fat is of great economic importance. The rendering of fat from suet, etc., for food purposes has already been mentioned. We should not stop at this in view of the experience of the British Army in reclaiming fat and grease. They find it well worth while to recover grease even from the dish water and utilize it for industrial purposes, especially in the manufacture of munitions.

KITCHEN AND MESS INSPECTION.

Everything pertaining to cooking and mess is to be scrupulously clean. The kitchen floor, sinks, storeroom, mess halls and tables must be clean and

in good order at all times. Stoves must receive careful attention and be kept clean, and the flues and fire boxes in good working order. A plentiful supply of *hot* water is essential. The floors of kitchen, mess hall and storeroom are to be scrubbed daily and swept and mopped after each meal. The best form of mess table has the top made of three boards, the center one being loose. After meals the table is to be scrubbed and the loose board set on edge to facilitate drying. All windows are to be kept clean and provided with screens; doors also must be screened. Flies must be kept out of and away from kitchen and mess hall by use of screens, fly traps, fly papers, "swatters," and any other means. The refrigerator is to be scrubbed each morning before new ice is put in. Care must be taken in arranging food in the refrigerator; open dishes of cooked food should not be placed in the bottom under the fresh beef where blood would be likely to drip in it. No dish containing food should be placed on another uncovered dish of food. All food in the refrigerator, except meat which is hung, is to be placed in dishes and not on the shelves or floor. It is advisable to disinfect the refrigerator once a week by washing with a solution of hypochlorite of lime or hypochlorite of soda.

Food in the storeroom is to be neatly arranged, shelves and floor to be kept clean and no food to stand directly on the floor. Platforms high enough to allow sweeping underneath should be built for boxes, G. I. cans and other food containers. Vegetables should be stored in bins. Special bins for

potatoes, onions, turnips and the like should be built and be so arranged that they are easy to fill, empty and clean as described in the chapter on Storage. G. I. cans are the best containers for flour, meal, rice, sugar and the like. Salt should never be placed in G. I. cans.

Kitchen utensils must be kept clean and polished at all times. Saws and knives for cutting meat should receive particular attention; see that the blades are clean, especially at the junction with the handles. Pots, pans and other utensils should be hung up or arranged systematically, so that any article can be readily found when needed.

New utensils should be thoroughly cleansed before using by boiling out for an hour with water containing a spoonful of washing soda. They should then be scoured with soap, rinsed out and reboiled with fresh water. Copper or nickel-plated ware is best cleaned by scouring with a mixture of fine sand or ashes and salt.

The fine ashes from the ranges are admirable for scouring purposes. Fine sand and brick dust are other useful scouring materials, but they should be boiled with water to kill any organisms that might be present before they are used to clean kitchen utensils.

After use all pots should be filled with water and boiled thoroughly, then scoured, rinsed in clean hot water and dried.

The meat table or block should be well scraped each day and scoured with hot soapy water and *washing soda.* Its use should be restricted to the

cutting and preparation of meat. It should be free from cracks, as these are likely to become infected and thus infect the meat. If in any way defective it should be repaired or resurfaced.

Dish washing in mess houses can be taken care of in many ways, but the best method and that which contributes most to the comfort of the men is to have it done under the mess sergeant's supervision by a special detail. The method of having the men dip their mess kits or dishes into one tub of water and rinse them in a second, the water of both becoming increasingly dirty and greasy as the number of kits dipped into them grows, should be used as a last resort, since it is inefficient and insanitary. The ideal scheme, and one which is proving satisfactory in a number of cantonment messes, is for men to leave their kits or dishes on the tables just as at home, and let the dining-room orderlies or a special detail collect them, remove the garbage, wash them in plenty of clean, hot, soapy water, and finally rinse them in clean, *hot* water.

Generally, and especially during the prevalence of contagious disease, it is desirable to sterilize all dishes used by the men more perfectly than can be done by any mere washing process. An appliance for this purpose is shown in Fig. 5. This is simple, cheap and convenient, the container for boiling water being an ordinary G. I. can.

Some messes use a punishment squad to wash the dishes. When the men in the mess finish eating they file by the serving counter and turn over knives, forks and spoons to one washer, plates

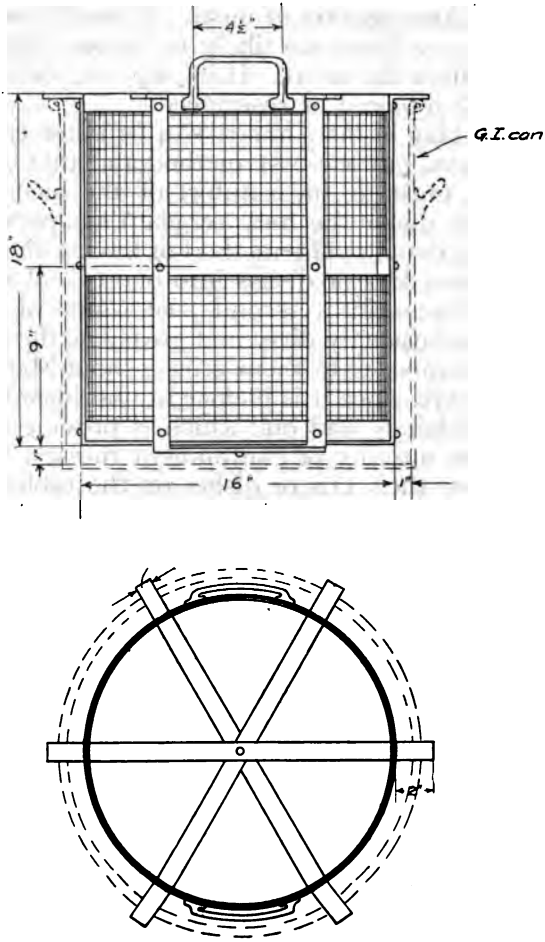

Fig. 5.—Sterilizer basket for dishes.

to another and cups to a third. After the dish-washing has been completed the squad stands at attention awaiting inspection of their work. They are permitted to eat only after the inspection proves that the washing was properly performed. This practice of enforcing kitchen service for company punishment is not a good one. Work in the kitchen should not be treated as undesirable; and besides, the duties of the cooks and mess sergeants are arduous enough without burdening them with the problem of unwilling kitchen police. However, if the mess sergeant is a good disciplinarian, dish-washing can be handled in the manner just described.

The system of twenty-four-hour details for kitchen police does not contribute to the successful management of a mess, since the men have not time to become efficient in their work. So far as practicable, kitchen police should be assigned for seven-day duty.

Daily inspection of messes is necessary to keep them up to a high standard of efficiency. Such inspection should not be perfunctory in nature, but

DESCRIPTION OF FIG. 5

Sterilizer for dishes. This sterilizer is constructed of large mesh wire netting fastened to a frame of strap iron. The frame is of riveted construction. The wire basket, formed by the netting and strap iron frame, is of such a size as to fit into a G. I. can, leaving one inch clearance all around. Method of using the sterilizer: Wash the dishes in hot, soapy water, using brush or cloth. Rinse in cold water, then place dishes in basket, submerge them in water in the G I. can and boil for fifteen minutes. The basket containing the dishes is then removed from the boiling water, the dishes being allowed to drain until dry. No wiping is necessary.

should be made systematically, according to some set form, as, for example, along lines suggested below:

(*a*) *Mess Sergeant.*—

Has he been recently examined and found free from disease, *e. g.*, venereal or typhoid?

Is he neat, clean shaven, and are his clothes in good condition?

Is he attending to his duties and alert to the responsibility of his position?

Does he exercise proper discipline over the cooks and kitchen police?

Does he prevent loitering in the kitchen?

Does he prevent any insanitary practice, such as expectoration, shaving, etc., in the kitchen?

Does he keep his accounts accurately and up to date?

Is he intelligent, economical and honest in his purchase of non-issue stores?

Is he capable of writing sensible and properly balanced menus and does he keep them posted as required?

(*b*) *Cooks and Kitchen Police.*—

Have they recently been examined and found free from disease, *e. g.*, venereal or typhoid?

Are their persons clean, their nails clean, and are they shaven?

Are the cooks dressed in white as regulations require?

Are their clothes clean?

Do they carefully wash their hands after use of *the latrine?*

Is there evidence of sickness or any diseased con-
:ion?
Are they preparing the food properly?
Are the kitchen police on seven-day detail?
Do they pay proper respect to the mess sergeant's
ders?
Are there plenty of clean towels for their use?

(*c*) *General Condition of the Kitchen and Mess* *ıll.*—

Are they clean and orderly?
Are they well ventilated?
Are there toilet facilities (when authorized) for e kitchen force and are they kept in proper ndition?
Do all such special latrines carry a poster instruct-g the mess personnel that they must never return the kitchen or mess hall without washing their ınds?
Are the floors cleaned after each meal?
Are they scrubbed daily?
Are the tables scrubbed and are the openings or acks free from dirt?
Are the center boards loose so that they may be moved for proper cleansing and is it the practice remove them? Boards, if rough, may be painted ith white lead and turpentine and then varnished ith spar varnish.
Are the windows clean?
Are the windows properly screened and are the reens in good condition?
Are there any flies present? If so, why?
4re proper fly traps provided?

(d) *Storerooms.* -

Is there a storeroom for laundry and clothing of men working in the kitchen?

Are they clean?

Are they well ventilated and protected from the heat of the sun and kitchen range?

Are the foods kept in good order?

Are they neatly stored?

Are all foods kept covered or in closed containers?

Are the containers properly marked to prevent [illegible] salt and sugar?

Are [illegible] provided to keep the food [illegible]

[illegible] bins for bulk foods properly [illegible]

[illegible] economy in purchase [illegible] on the part of the mess [illegible] quality and size of con- [illegible]

[illegible] and cleansed or is [illegible] remaining small [illegible]

[illegible] free from [illegible] clothing, [illegible]

[illegible] on the floor [illegible]

[illegible] in the refrig- [illegible]

Is it washed with a solution of hypochlorite ("chloride") of lime once a week?

Are the various foods properly stored in it?

Are dishes containing food allowed to be placed under the hanging meat, where they catch the blood and drippings therefrom?

Is there any unwholesome meat present?

What are the left-overs?

Have they been kept more than twenty-four hours?

Are left-overs put in while still warm?

Are there foods in the refrigerator which do not properly belong there?

Is any food placed directly on the shelves or floor and not in proper pans?

Are there plenty of hooks on which to hang meat?

Is the refrigerator placed at a proper distance from the stoves?

Is there plenty of ice?

(*f*) *Bread Box.*—

Is it kept clean?

Does its construction permit ready cleaning and use of old bread first?

Is it dried after cleansing before replacing the bread?

Is it placed on a table or counter or upon or near the floor?

Is it of ample capacity?

Are the loaves of bread stored on end or piled on top of each other?

Is its use restricted to bread?

Is it properly ventilated, not too much nor too little?

Is there evidence of economy in the utilization of left-over bread?

(*g*) *Stock Pot.*

Is there one?

Is it used constantly?

Is the excess of grease from it utilized or saved?

Is it emptied, cleansed and provided with absolutely fresh contents every day?

Are the contents absolutely sweet and wholesome?

(*h*) *Kitchen Utensils.*—

Are the pots and pans properly scoured?

Are they hung up or stored in a neat and orderly manner?

Are the knives, forks, spoons, ladles, cleavers and meat saws scrupulously clean?

Are they hung up in their proper places?

Are there plenty of clean towels for proper drying of all utensils and dishes after washing them?

(*i*) *Ranges.*—

Are they in good working order?

Are the tops and ovens clean and used only for their proper purposes?

Are the ranges kept polished?

(*j*) *Menus.*—

Are they posted in the kitchen if required by regulations?

Do they indicate ample provision of food?

Are they varied?

Is the diet properly balanced?

Do they provide for utilization of left-overs?

Do the cooks adhere to the posted menus?

(*k*) *Garbage Cans.*—

Are they kept clean?

Is the garbage properly separated?

Is there an excessive amount of waste in them?

Is there any apparently good food present?

(*l*) *Mess Attendance.*—

Is there order in the mess hall?

Are the men required to wash before meals, to be clean shaven and to comb their hair before coming to meals?

Are their clothes clean?

Do they take care to avoid spilling foods, gravy, coffee, syrup, etc., on the tables?

The personnel of the kitchen and mess hall must at all times be clean and healthy and present a neat appearance. The men must be clean shaven, hands and finger nails clean, hair combed; cooks, if possible, to be in white suits and aprons; kitchen police, when serving food to the tables, should wear white aprons and at other times blue denim. The kitchen force should be examined by medical officers at least weekly to determine whether they are carriers of disease. It is possible for an apparently healthy person to be the carrier of typhoid and other germs, probably unknown to himself, and to be the innocent source of danger to those for whom he prepares food. None but the most clean and healthy men should be used. Care must be taken to insist upon the observance of the rule that all members of the mess personnel *wash their hands* after visiting the *latrine*.

The following form is suggested as a convenient method of rating the condition of the mess:

MESS INSPECTION FORM.

Date ....
CAMP........ ORGANIZATION.......... Observer ....

STOREROOM:							
Clean?							
Orderly?							
Sufficient platforms?							
Fruits and cereals covered?							
Vegetables properly stored?							
Canned goods in good condition?							
Flies, ants, roaches, weevils, mice?							
KITCHEN:							
Clean?							
Orderly?							
Equipment adequate?							
Scales provided?							
Stock pot used correctly?							
Grease pot used correctly?							
Cooking apparently good?							
Quality of food good?							
Refrigerator satisfactory?							
Bread box satisfactory?							
Waste apparently excessive?							
Knives and cleavers sharp?							
DINING ROOM:							
Clean?							
Large enough?							
Light and well ventilated?							
System of service. Line?							
OUTSIDE:							
Garbage cans clean?							
Waste apparently excessive?							
Grease trap used properly?							
Incinerator satisfactory?							
Proper facilities for washing mess kits?							
Mess hall properly screened?							
Fly traps properly used?							
Grounds well policed?							
GENERAL:							
Number of men fed?							
Number of rated cooks?							
Number of assistant cooks?							
Number of K. P.'s?							
Length of K. P. detail, days?							
Menus satisfactory?							
Accounts well kept?							
Amount of mess fund, dollars?							
Percentage bought outside?							
Mess sergeant capable?							
General impression of mess, good, fair *bad?*							

Y = *Yes;* *X* = No.

Remarks:

MENUS.

Important service can be rendered by the mess officer in supervising the construction of bills of fare. These should be made out in advance, with particular reference to what the commissary affords and as to what is to be found in local markets in the way of fresh fruits and vegetables or the food required for variety. When meats are received the cheaper cuts should be used first, especially the bony portions; the latter spoil more rapidly than other portions. As previously mentioned, the mess officer should acquaint himself with the principles of nutrition and should be able to criticise the figures of the mess sergeant and to correct the menus when necessary in order to obtain balance and variety. It is the duty of the mess sergeant to make out the menus, which are then handed to the mess officer for criticism and approval. The principles to be followed are given in other chapters.

CHAPTER VII.

THE DUTIES OF MESS OFFICERS.

THE mess officer is accountable for the proper feeding of the troops. Both the health and the morale of an organization may be seriously impaired by defective nutrition, and this adverse effect is more frequently due to improper selection or poor preparation of good materials than to originally inferior supplies. The mess officer, charged with the duties of selecting and supervising the preparation of food for the fighting units, is therefore placed in a position of great responsibility and importance. Too often the duties of mess officers are added to those of a man already otherwise busy, who is likely to forget that proper mess management is as important as any other duty that may be assigned, and that no effort must be spared to ensure the best possible nutritional conditions that the circumstances permit.

THE DUTIES OF BATTALION OR COMPANY MESS OFFICER.

These duties may be enumerated as follows:

1. He has been appointed to see that Army Regulations Nos. 296 to 302 are complied with.

2. *Articles* 2318 to 2333 of the *Manual for the Quartermaster Corps* deal with the various rations;

the mess officer must therefore be familiar with them.

3. He should know the principles of nutrition, and valuation of food; he should learn to judge the quality of foodstuffs and understand the principles of kitchen economy.

4. He should ascertain whether the mess sergeants under his control are efficient in the discharge of their duties, and take steps to adjust any defects along these lines.

5. He must inspect his kitchens and mess halls at least daily for the purpose of ascertaining that they are in a clean and orderly condition, and that the management by the mess sergeant ensures proper discipline. The kitchen should be ready for inspection at a fixed hour, but needless to say the time of inspection should vary from day to day.

6. He should make frequent inquiries of the medical or sanitary officer who is responsible for the sanitary inspection of his mess or messes, and learn from this officer any criticisms on the condition of his kitchens.

7. He should inspect all foodstuffs in the kitchen as to quality and see that credit is obtained for all supplies received unfit for food.

8. He should see that foods are properly stored; and if not, show how proper storage facilities may be obtained.

9. He should ascertain by daily examination that the food is properly prepared and palatable. This can be done only by frequently tasting it and preferably by eating an occasional meal in the mess

10. He should require the mess sergeant to confer with him on the preparation of menus.

11. He should see that the diet is properly varied. Monotony of diet may be as serious as improper preparation of food.

12. He should also see that the diet is properly balanced and insist that the menus are followed as posted.

13. He should see that the food is being used with the greatest economy and that none is wasted.

14. He should supervise the expenditures for foods, and give the mess sergeant directions concerning the purchase of non-issue articles, and see that mess accounts are carefully kept and up to date.

15. In addition to the daily check-out, he should require the mess sergeants to make an actual inventory of the food on hand at the end of either weekly or ten-day periods, since the running account of daily withdrawals is never quite correct, due to depreciation and to the fact that the cooks do not accurately record the various amounts of foods which they take from the storeroom.

16. He should learn what the men purchase at the canteen, and, so far as possible, satisfy their craving for cakes and sweets in the mess. The purchase of much food of this character by the men is a direct criticism of the mess management.

17. The mess officer is responsible for the proper messing of the men when travelling, concerning which he should study Articles 3475 to 3486 of the *Manual for the Quartermaster Corps*.

18. Until he has acquired considerable familiarity with the subject, he should systematically devote some time to technical reading on foods and nutrition.

19. He should make an effort to instruct the men of his mess in the uses of the different kinds of foods and in the hygiene of eating, particularly as applied to food or beverages consumed outside the mess. Such instruction may be given by the use of large cards conspicuously displayed in the mess hall. The cards should bear short, pithy statements and should be changed at frequent intervals.

THE SPECIAL DUTIES OF THE HOSPITAL MESS OFFICER AND OF HIS STAFF.

The duties of the commanding officer of the base hospitals of the division camps and other large military hospitals have grown so heavy during the present war that it has become necessary for them to delegate the duties assigned to them in Paragraph 234 of the *Manual for the Medical Department* to the mess officer; this in turn greatly increases the responsibility of the latter.

The mess officer must, of course, be a man whose probity is beyond question. He is the executive of the hospital messes and as such is responsible only to his commanding officer.

ORGANIZATION.—It has been found to be more economical of both time and material for the mess officer to have charge of all of the messes of the hospital. This enables him to buy for the entire organization, and so he is in a position to demand better prices and accommodations. This plan, too

localizes responsibility and presumably places a man in charge who understands what is required and knows how to get it. Such a consolidated mess demands a mess officer who is, above all things, an executive and an organizer. The following scheme of organization may be adopted:

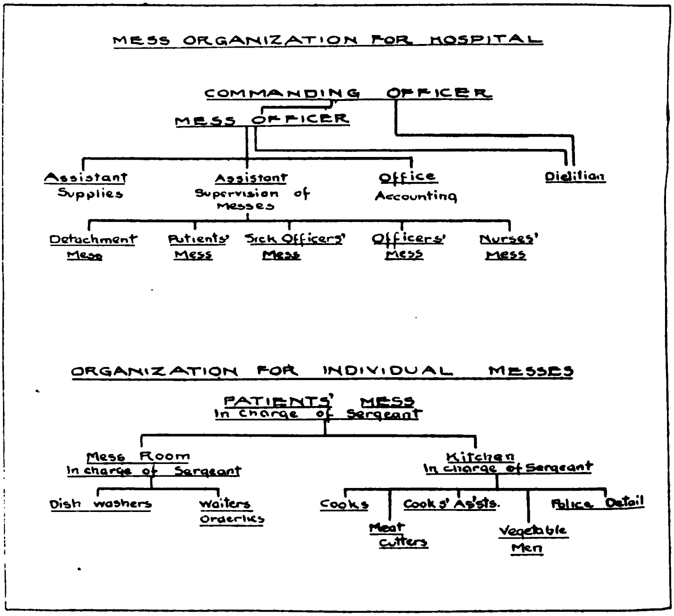

FIG. 6.—Scheme of mess organization.

In the smaller messes the organization may be reduced. Thus, a sergeant should be able to handl

both dining-room and kitchen for the officers' and sick officers' messes. It is usually more satisfactory to put a nurse or dietitian in charge of the nurses' mess. The sergeant in charge of the detachment mess and of the patients' mess in the smaller hospitals can also take immediate charge of either the mess hall or kitchen. In smaller hospitals, too, the mess officer himself will be able to assume the duties of the mess assistant.

1. *The Mess Officer*, as above noted, is responsible to the Commanding Officer of the hospital under Army Regulations for the condition of all messes belonging to the hospital.

He is responsible for quantity, quality of food and proper preparation and service. He is responsible for all funds necessary to run the several messes, and in some places the canteen. He therefore makes all collections and pays all bills. He must keep a set of books adequate to account for all transactions and to show at all times the exact financial condition of the storeroom and of each of the messes under him. Since ultimately he is responsible for the condition of all the messes, he should make a thorough daily inspection of each and should hold such conferences with his personnel as seem desirable.

He should satisfy himself by frequent inspections made at definite intervals that all men coming in contact with the food in any way are free from all diseases which might be communicated to those dining in any of the several messes. The *Commanding Officer* should determine what such diseases are, the appropriate intervals of inspection and

proper officers to make the inspections. Carriers of typhoid, and persons suffering from venereal or any other type of contagious disease, should be eliminated from the personnel until free from the disease.

It is the duty of the Mess Officer to satisfy himself of the ability and integrity of the personnel under him, and to see that they are properly instructed and trained.

2. *Supplies Assistant.*—He may be made responsible to the Mess Officer for the procurement, storage and issuing of stores and supplies. Thus, he may be charged to see that the stores are properly kept, that an actual count is made of all stores received and that proper records are kept. He should also keep a record of all goods issued to the several organizations and see that each is charged with all goods received by it.

3. *Mess Assistant.*—He is immediately responsible for discipline, training and efficiency of the personnel and cleanliness and economy in the several messes. He should receive the menus from the several sergeants and from the dietitian. These menus are to be turned over to the stores assistant in ample time to allow the purchase and delivery of the necessary goods.

He is responsible to the Mess Officer for the amount of garbage from the several messes and should take such steps as are necessary to reduce it to the lowest possible level. He should weigh the garbage from both the dining rooms and kitchens of the several messes at intervals determined by the Mess Officer.

He should render such assistance to the dietitian as is necessary to ensure complete coöperation of the cooks and storeroom personnel.

4. *The Dietitian.*—It is her duty to prepare menus for all patients in the hospital. She is to see that the food is properly prepared and served. She should see that the menus are served as written.

She should be present in the kitchen during the preparation of meals. However, during the service she should divide her time between the wards and mess hall in such a way that she may know whether the food is being properly served throughout the hospital. She or her assistant is responsible for the issuing of the food to the wards. She should also report to the Commanding Officer defects of service found in the wards, that these may be corrected through proper channels. Defects of preparation or service found in the mess hall or kitchen should be reported to the Mess Officer.

She is directly responsible for the preparation of special diets and for special items or modification of the three listed diets. She should, however, be supplied with sufficient help to relieve her from all the details of preparation of these items. It is her duty to advise with the heads of the services, ward surgeons or nurses as may be necessary to ensure the patients getting food that is adapted to their needs, while at the same time the kitchen may be relieved of preparing unnecessary specials.

5. *The Mess Sergeants.*—They have direct charge of their respective kitchens and mess halls. They are responsible for the promptness of the prepara-

tion of the meals, and for the condition in which the food is turned out. They are responsible to the mess assistant for the condition and conduct of the men in their charge, and for the proper condition of the kitchen. They prepare all menus not prepared by the dietitian.

In very large messes they may be provided with one or more assistants. In the patients' mess it may be desirable that the mess sergeant have two assistants, one in charge of the main kitchen and the other of the mess hall.

The diet kitchen should be in charge of an assistant dietitian or of a competent corporal or sergeant responsible to the dietitian.

6. *Office Sergeant.*—He shall be responsible to the mess officer for the paper work of the mess. This will include property and personnel in so far as records and paper work are concerned. Included with this would be such records as are necessary in conjunction with the medical inspection of the personnel. He also is responsible for the mess bookkeeping.

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CHAPTER VIII.

GLOSSARY.

ADIPOSE—pertaining to fat.

ALIMENTARY CANAL—the tube extending from the mouth to the anus, the function of which is the digestion and absorption of the nourishment for the whole body. It consists of the mouth, pharynx, esophagus, stomach, the small intestines, large intestines and the rectum.

ALKALOID—a nitrogenous base, especially one of vegetable origin, which even in comparatively small doses is capable of producing marked poisonous effects on the animal organism.

AMORPHOUS—having no determinate form.

ANTISCORBUTIC—relieving or preventing the disease scurvy.

BACTERICIDAL—referring to an agent which is destructive of bacteria.

CECUM—a blind pouch situated at the opening of the large intestine.

CARTILAGE—a strong, translucent, elastic tissue, which with time usually changes into bone.

CAUL—an apron-like structure loaded with fat covering the intestines.

CHYME—the pulpy mass of semidigested food in the small intestine after its passage from the stomach.

COD—the external bag or pouch which contains the testicles.

COLLOID—a substance in a peculiar state of aggregation, characterized by slow diffusibility or permeability, such as a solution of gum.

COLON—the main portion of the large intestine running from the cecum to the rectum.

COSTAL—referring to ribs.

DIAPHRAGM—the muscular and tendinous partition separating the cavity of the chest from the abdomen.

DUODENUM—the first portion of the small intestine between the stomach and the jejunum; the pancreatic duct and the bile duct enter it.

ENZYME—a complex organic compound which is capable of causing changes in other compounds without itself entering into the reaction. Thus, the "enzyme" or "zymase" contained in yeast is capable of transforming sugar into alcohol and carbon dioxide although the enzyme does not enter into either of these compounds.

ESOPHAGEAL—pertaining to or near the esophagus.

ESOPHAGUS—the tube which leads from the pharynx to the stomach.

FERMENT—same as Enzyme.

FOODSTUFFS—products from which food is prepared; material for food.

FUSARIUM—a genus of destructive parasitic fungus.

GUT—same as Intestine.

ILEOCECAL—pertaining to or situated near the ileum and the cecum.

ILEOCECAL VALVE—the valve which separates the small and the large intestine.

ILEUM—the lower portion of the small intestine.

INGESTION—the process of taking or putting food into the stomach.

INTESTINE, LARGE—separated from the small intestine by the ileocecal valve, and is divided into the cecum, the colon and the rectum.

INTESTINE, SMALL—consists of the duodenum, the jejunum and the ileum.

ISCHIUM—the lower and posterior of the three principal bones composing either half of the pelvis.

JEJUNUM—the middle portion of the small intestine.

KINETIC ENERGY—the (units of) energy which a body possesses by reason of its motion is called kinetic energy.

MASTICATION—the chewing or crushing and grinding of food with the teeth in preparation for swallowing.

MOLECULES—the smallest complete particle of a substance.

MUCOUS MEMBRANE—the lining of the passages and cavities of the body which communicate directly or indirectly with the exterior—such as the alimentary, the respiratory and the genito-urinary tracts.

OMENTAL FAT—the fat covering the intestines.

ORGAN—any part of a plant or animal performing some definite function.

OSSIFY—to convert to bone.

PARASITE—an organism that lives on and derives its nourishment from some other organism.

PELVIC BONE—the bone which forms the girdle or basin by which the thighs are joined to the body.

PERIPHERAL—pertaining to the surface.

PERITONEAL CAVITY—the cavity lined by the peritoneum; a serous membrane which envelops the viscera.

PERISTALSIS—a peculiar, progressive contractile muscular movement of any hollow organ of the body, particularly of the alimentary tract, whereby the contents of the organ are gradually propelled toward the point of expulsion.

PHARYNX—that part of the alimentary canal which lies between the mouth and the esophagus.

POTENTIAL ENERGY—that energy which a system possesses by virtue of the relative position of its parts: thus, a weight raised above its previous level thereby acquires the power to do work in falling; this power is known as potential energy.

RECTUM—that portion of the alimentary tract which extends from the colon to the anus.

REFLEX—the action produced by the transmission of an impulse which is independent of the volition, or an automatic action such as the winking of the eye when threatened.

REGURGITATE—to rush backward or upward.

SCROTUM—the same as Cod.

SECRETE—to emit.

SPECIFIC HEAT—the quantity of heat necessary to raise the temperature of one gram of a substance through 1° C. is called the specific heat of the substance at that temperature. The higher the specific heat of any substance, therefore, the more heat necessary to change its temperature.

SPERMATIC CORD—the cord which suspends the testicle within the scrotum.

SPHINCTER—a ringlike muscle surrounding and able to contract or close a natural opening or passage.

SPORE—a minute organic body or germ that develops under suitable conditions into a new individual. It holds on to life with great tenacity.

SKELETAL MUSCLES—muscles attached to the skeleton.

TISSUE—one of the elementary fabrics of which an organ is composed, formed by cells and their products arranged in a definite manner.

Ultimate Composition—the names of the constituent elements of a substance, together with the proportion by weight in which they are present.

Viscera—a general name for the internal organs.

Viscosity—the property of a liquid, gas or semi-liquid by which it resists a change of position or shape; slow-flowing character.

Vitamine—see Chapter I, page 16, and Chapter V, page 109.

LIST OF ADDITIONAL REFERENCE BOOKS.

1. In addition to the books recommended on p. 139, the following may be mentioned as desirable for those officers who wish a more thorough course of reading. Some or all of the books will be found in any base hospital or post library.

Ford—*Field Hygiene and Sanitation.* P. Blakiston's Son & Co., Philadelphia, 1917.

Summary: This book covers in detail the sanitary features of messing, and includes numerous drawings of mess halls, tables, incinerators, storage tents, etc.

Lelean—*Sanitation in War.* P. Blakiston's Son & Co., Philadelphia, 1917.

Summary: Covers the same field as Ford, but deals with the British practice.

Ashburn—*Elements of Military Hygiene.* Houghton, Mifflin Company, Boston, 1915.

Summary: Chapter III gives an excellent summary of the minimum knowledge of nutrition necessary to secure a good mess.

Havard—*Military Hygiene.* William Wood & Co., New York, 1914.

Summary: Chapters XXIV to XXXII cover in detail various kinds of food, their preservation, preparation and uses in the dietary. Very complete on this subject.

Mason—*Handbook for Sanitary Troops.* William Wood & Co., New York, 1912.

Hornsby Schmidt—*The Military Hospital.* W. B. Saunders Company, Philadelphia, 1914.

Summary: Particularly useful for descriptions of mechanical kitchen equipment; also mess accounting.

2. As sources of information for the more advanced student of nutrition, the following should be read:

Lusk—*Science of Nutrition.* W. B. Saunders Company, Philadelphia, 1917.

Sherman—*Chemistry of Food and Nutrition.* Macmillan Company, New York, 1918.

Friedenwald, Ruhräh—*Diet in Health and Disease.* W. B. Saunders Company, Philadelphia, 1917.

Pattee—*Practical Dietetics.* Pattee, Mt. Vernon, 1918.

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